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ABSTRACT

This masters thesis is a study of the possibilities of managing various insects for educational or esthetic purposes. The study focused on several insect groups: (1) butterflies, (2) ants, (3) ant lions, (4) tiger beetles, and (5) whirligig beetles. As part of the work on butterfly management a butterfly garden, complete with maintained mud puddles, was established and observed. The plants in this garden and the insects attracted to them are listed. Observations were recorded of the butterflies feeding on native wildflowers in the Clear Creek Valley area of Ohio and a butterfly census was taken in that area. In addition to the work done investigating the management of these insect groups, a rotting log study was done to record the succession of insects in such a microhabitat. For each of the sections of this thesis, which are like separate studies, introduction, methods, results, and discussion sections are given. Data are presented in tables. Some color photographs of insects are included as well. An index of scientific and common names of species mentioned in the paper is included. Appended is a publication generated from this work entitled "A Guide to July Butterfly - Wildflower Observing in Ohio's Clear Creek Valley and Several Adjoining Areas." (MR)

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THE POTENTIAL FOR MANAGING VARIOUS INSECTS AND THEIR HABITATS FOR EDUCATIONAL PURPOSES

A Thesis

Presented in Partial Fulfillment of the Requirements
for the Degree Master of Science

by

Susan G. Kains, B.S.

The Ohio State University
1978

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TABLE OF CONTENTS

	Page
Acknowledgements	ii
List of Tables	iv
List of Figures	v
Introduction	1
Butterflies	10
The Garden	13
Introduction	13
Methods	14
Results	16
Discussion	23
Observations of Feeding Butterflies at Nectar Sources	25
Introduction	25
Methods	26
Results	26
Discussion	26
The Census	36
Introduction	36
Methods	37
Results	40
Ants and Plants	51
Introduction	51
Methods	52
Results	54
Discussion	63
Ant Lions	67
Introduction	67
Methods	70
Results	72
Discussion	73

Page

The Succession of Insects on Three Decomposing Logs..... 78
Introduction..... 78
Methods..... 78
Results..... 79
Discussion..... 80
Tiger Beetles..... 89
Introduction..... 89
Methods..... 95
Results..... 97
Whirligig Beetles..... 99
Introduction..... 99
Methods.....100
Results.....101
Discussion.....102
Conclusions.....105
Literature Cited.....106
Index of Scientific and Common Names.....109
Appendix.....114

LIST OF TABLES

TABLE		PAGE
1.	Affiliation of Environmental Centers	6
2.	The Use of Insects in Environmental Programs	8
3.	Plants of the Barnebey Butterfly Garden	17
4.	Garden Plants which Succeeded in Attracting Butterflies	19
5.	Nectar Sources of the Clear Creek Valley	28
6.	Species of Butterflies Encountered on the Census	41
7.	Ant Reaction to Introduction of Arthropods on *Vicia sativa*	53
8.	Size of *Vicia sativa*	58
9.	Invertebrates of Three Decomposing Logs	83

LIST OF FIGURES

Figure		Page
1.	*Polygonia sp.*, a frequent visitor to the synthetic puddles of the garden	21
2.	*Everes comyntas* engaged in sipping moisture from wet sand	22
3.	*Hemaris sp.*, a diurnally feeding moth often encountered in the Clear Creek Valley	27
4.	*Echinacea purpurea*, Purple coneflower, attracts many species of butterflies	45
5.	*Asclepias tuberosa*	46
6.	*Vernonia novaboracensis*, New York Ironweed blooms in autumn and attracts many species	47
7.	*Speyeria cybele* is attracted to Buttonbush blossoms	48
8.	The American Painted Lady feeds at thistles	49
9.	*Everes comyntas* feeds at various plants	50
10.	*Vicia sativa*, Spring Vetch, possesses extra-floral nectaries	56
11.	A close-up of an extra-floral nectary on *Vicia sativa*	57
12.	The typical feeding position of a Formacine ant at a nectary	59
13.	Percent marked ants recovered on *Vicia sativa* in relation to time since marking	61

Figure Page

14. Passiflora incarnata has nectaries..... 65
15. The larva of Myrmeleon immaculatus..... 68
16. The wooden shelter constructed for ant lions..... 71
17. Trailmaking and Pit building of ant lion larvae..... 74
18. A beech log with a plexi-glass inlay..... 75
19. The beech log as a display-shelter..... 77
20. Cicindela sexguttata, an active predator of woodland paths..... 90
21. The range of Cicindela sexguttata..... 91
22. The adult beetle retaining cage..... 92
23. An immature tiger beetle..... 93
24. Burrow holes of Cicindela sexguttata... 94

INTRODUCTION

The insects have achieved, throughout millions of years, such an incredible diversity of form and function that they have had an impact on almost every living organism. Their diversity and adaptability have linked them to mankind's future through their major roles in public health and agriculture. Oddly, insects are simultaneously condemned for competing with humans for food, and applauded as pollinators and decomposers. In short, their influence on our environment is so profound that all people should have a practical knowledge of insects.

A broader understanding of life has been derived from many of the classic studies of insects. The extraordinary instincts compelling the social insects to dwell in intimate associations has aroused the keen interest of many observers. William Morton Wheeler, whose classic work on the structure, development, and behavior, of the ants, has contributed significantly to further understanding of the insects which outnumber, in individuals, all other animals on earth,(meaning

terrestrial animals). Karl von Frisch's work revealed the ability of the honeybees to distinguish different colors and odors, which play an important role in the homing of bees. Studies of the digger wasp by Niko Tinbergen revealed an unsuspected plasticity of behavior in the insect world. During the 19th century Jean Henri Fabre, distinguished for his insect life histories and studies of instincts, suspected that the sexual odors of female Noctuid moths attracted the male moths. This was proven in 1926 by von Frisch. Today, practical applications of the classic research has evolved into programs such as gypsy moth monitoring and honey bee management.

Insects may logically be studies for their own intrisic worth. During millions of years they have evolved into the most bizarre group of animals ever to run, hop, jump, crawl, swim, fly, or hitchhike on the earth. They have exploited every conceivable habitat. Their habitats, however, are often limited in size, which makes feasible the creation of suitable places where observations may be made. This existence in a very limited area facilitates the demonstration of functioning ecosystems. No other group of organisms has more potential for generating an understanding of functioning ecosystems, than do insects.

The details of life histories of the most conspicuous forms are generally well known yet for many people, insect

study is a new experience. If presented well, the experience can be very stimulating. Insects' size, availability, the ease with which they are reared, and the biological principles they can demonstrate, all contribute to the value of including insects in educational programs. The aesthetics of studying insects as living organisms should not be forgotten and buried beneath the content coursework necessary in scientific training.

Particularly significant is the importance of exposing young children to insects to avoid development of entomophobia, unnecessary fears towards these animals. Negative feelings towards animals are frequently a result of limited personal experiences (Bem: 1970). Studies such as Davis' (1976), where the ranking of natural history preferences among children revealed insects to be generally excluded, challenge naturalists, teachers, and interpretors to develop more approaches that would present insects in a positive role.

The newest phenomenon in education with insects is the insect zoo. Two of the three existing insect zoos of the world, are in the United States. The third is in Japan. The insect zoo at the Smithsonian Institution in Washington, D.C. is now open to the public. The Cincinnati Zoo is scheduled to open its insect displays in 1978. The insects at the Smithsonian's insect zoo are maintained and

exhibited in indoor displays and represent animals from several countries.

Observing insects in their natural habitats is an important approach which needs to be retained. Involving students in the creation of an insect study-management area within a school yard, for example, could contribute to a unique positive encounter with insects. It is recognized that direct participatory experiences, and the information gained through them, can produce a reorganization of attitudes (Kress: 1975). It follows that one goal of an insect management area would be to promote and foster an awareness of insect conservation.

In the projects which follow, several insect species were selected for study to determine the feasibility of using them in outdoor living displays (management areas). All were native Ohio insects representing common and active species. Some have been overlooked by the keenest naturalists, since they may occur singly in the wild, and are not obvious. Nevertheless, they are all performers, each in a unique and valuable role. Any insects which were collected and moved, occur normally within the area of the Barnebey Center, Fairfield County, Ohio. They should not present any unnatural problems, since some of the areas were those which they might colonize in time.

There are many insects which lend themselves well to

observation in a natural setting. Time, however, allowed for study and observation of only a few of the insects which deserve attention and of the habitats which offer possibilities for study and demonstration. Recommendations related to future projects are included in the final pages of this paper.

In order to learn what was currently being done in exploiting the educational and aesthetic value of insects, a list of 287 Environmental Education facilities was compiled from the Directory of Environmental Education Facilities published by the National Audubon Society, A Guide to Ohio Outdoor Education Facilities prepared by Ruth Melvin for the State of Ohio, and the 1975-1976 Directory of Natural Science Centers published by the Natural Science for Youth Foundation. The centers represented a variety of federal, state, county, city, private, public school, and university affiliated facilities (Table 1). Each received a letter of inquiry, an example of which appears in the Appendix. The letter was written with a personal approach because it was thought to be the best way to encourage an exchange of ideas, information, and observations.

In addition, a literature search was done with the aid of the Mechanized Information Center. Key words included nature, centers, insects, programming, teaching, and natural science. Little was uncovered about insects

TABLE I. Affiliation of Environmental Centers

Agency	Number of this type
Private	29
Church	7
State	8
County	7
City	5
Federal	6
Public School	11
University	4
TOTAL	77

or outdoor insect management areas.

Eighty-seven centers within twenty states responded to the inquiry. Seventy-seven provided descriptions of the role of insects in their programming. Many included additional information in the form of pamphlets and brochures. Most agreed that insects indeed should be considered in developing programs or natural history studies. Table 2 describes the various uses of insects in those programs. Twenty-five centers augmented the trail discussion approach with specific programs involving participatory experiences with live insects. One would expect more than forty-two centers to develop discussions emanating from trail discoveries since this rather basic approach requires no planning and little knowledge of the animal itself.

It is obviously easier to extract specimens for display from permanent preserved collections than to attempt to maintain live insects. The care required for the insects may discourage some persons. Much of the importance and fascination cannot be realized without seeing the animals alive where their reactions and behavior can be observed. Pinned specimans do however serve well in identification and taxonomic studies as well as in demonstrating diversity within the Class Insecta.

It is generally recognized that many of the social

TABLE 2. The use of insects in environmental programs

Approach	Number of centers utilizing the approach
Discuss or mention if encountered on a trail	42
Plan specific programs involving participatory experiences with live insects (excluding the collecting, preserving, mounting approach)	25
Maintain displays of live insects	
Social insects (6) Non-social insects (3)	9
Maintain non-living displays (models or preserved specimens)	8
Manage vegetation or land outside for insects	2

insects which carry on plant pollination are very beneficial to man. Functioning as a cohesive unit and dwelling in well-defined structures, the social insects have received more attention in live displays than the less well-known but by no means insignificant non-social insects.

Although only two centers specifically attempt to attract various insects or create outdoor living insect displays through management of vegetation, this approach could have great value, popular appeal, and could develop positive awareness.

BUTTERFLIES

Although butterflies have been popular as subjects of natural history since ancient times, they have not, until recently, received protection in the wildlife conservation movement. In 1976 the United States Fish and Wildlife Service applied the Endangered Species Act to butterflies and listed two as threatened and six as endangered. Indeed, many butterflies are declining because their habitats are being destroyed by rapid urban sprawl and other effects of human population pressure. This has been difficult to document since, in the past, wildlife interests were not concerned with this area of conservation. Kulman (1977) suggests that there is an apparent lack of interest in butterflies among applied entomologists which is related to an institutional indifference to the aesthetics of insects. The value of butterflies in developing interest in biology and natural history has been effectively discussed by Pyle (1976). Because many are attractive, abundant, and accessible, they have begun to be used in this

country in conservation education (Pyle: 1976). Kulman has brought together literature regarding butterfly production management, conservation, biology, and ecology. He suggests that although there exists a paucity of literature concerning population regulating factors, such as carrying capacity, there is observational data to encourage experiments. In butterfly production management, the species are selected on the basis of their potential success in responding to management, viewing potential, aesthetic qualities, and insignificance as pests without reference to rarity or endangered status (Kulman: 1977). Given such criteria, butterflies can be economically significant to nature centers, botanical gardens, parks and conservatories. Land of various sizes and plant diversity could utilize butterfly production management (Sullivan and Schaffer: 1975) (Miller: 1975). Although the primary goals of nature centers and parks is natural history observation and education (Pyle: 1974) (Jackson: 1976) (Heal: 1973), their value as experimental areas for butterfly management is beginning to be recognized (Kulman: 1977).

Literature regarding butterfly biology and ecology has been dealt with by Ford (1945), Gilbert and Singer (1975), and Pyle (1976). Gilbert and Singer (1975) have discussed the paucity of data relating to regulating

butterfly populations. Population monitoring information about butterflies has not accumulated significantly (with a few exceptions) beyond the general opinion that "butterflies aren't as noticeable as before."

Habitat management for butterflies can be approached in two ways. One way is to concentrate populations of adult butterflies for viewing without increasing the population size. The other way is to culture and/or plant larval host plants to induce breeding and enlarge the population of adult butterflies. The former approach was utilized at the Barnebey Center where a butterfly garden was planted in 1977. The garden was established specifically to determine whether particular wildflowers could survive transplanting or could be propagated from seeds, and would attract butterflies. The plantings represented species which occur locally as well as several which it was thought might be attractive but did not occur in the area.

Since information relating to the butterflies of the Clear Creek Valley and adjoining areas had not been assembled, two more tasks, appropriate to planning of management for butterflies, were undertaken. During late March to early September, feeding butterflies were observed at nectar sources in the vicinity of the Barnebey Center.

The third project involved the butterfly census of nine unique habitat types. The garden, the census, and the observations of adult butterflies at their nectar sources will be discussed in greater detail in the next few sections.

The overall objective of the butterfly projects was to gather information that could be useful in developing butterfly natural history studies and conservation plans in the Clear Creek Valley and adjoining areas. An information guide booklet entitled A Guide to Butterfly-Wildflower Observing in Ohio's Clear Creek Valley and Several Adjoining Areas evolved from the projects. It is included in the Appendix.

The Garden

Introduction

Butterflies are known to be attracted to tree sap, honeydew, dung, carrion, and even spittlebug foam, as reported in literature related to food preferences by Clark (1932), Saunders (1932), Norris (1936), Gilbert and Singer (1975). Generally speaking, most authors consider flower nectar to be an important energy source and Gilbert (1975) suggests that nectar feeding can increase longevity of an adult butterfly. Bernhardt

(1976) suggests that there are many species of plants with phenological, anatomical, and physiological characteristics in common that help predict if a plant will be fed on by butterflies. He encourages experimentation in butterfly gardening to determine which plants can be considered butterfly flowers. Different geographic regions of North America have different wildflowers as nectar sources and different butterfly densities (Jackson: 1977). These differences should be considered when planning butterfly management. Kulman (1977) states that little experimental data is available on nectar energy sources for butterflies but that flower color and nectar quality and quantity can be important factors. The practice of allowing weeds to flourish in a garden can provide a diversity of color as well as flat-topped flowers which are attractive to butterflies (Jackson: 1976).

Methods

On April 1, 1977, an area 7.5 X 8.8 meters was burned in preparation for butterfly plantings. The site was selected on the basis of its accessibility to water which could be carried from Clear Creek or Wildflower Run, its proximity to the forest edge, and the amount of available sunlight. The soil was determined to be

slightly acidic (ph 5.5) but low in phosphorous and nitrogen.

The garden site was located within an area best described as in old field succession. The woody plants found nearby generally ranged in size from one to three inches in diameter. Species represented were Juglans nigra, Liriodendron tulipifera, Prunus serotina, Acer negundo, Hypericum spathulatum, Nyssa sylvatica, and Acer rubrum. Herbaceous plants included Solidago sp., Allium vineale, Daucus carota, Achillea millefolium, Apocynum cannabinum, Galium sp., Glechoma hederacea and Vicia sativa.

It has already been stated that some butterflies are attracted to animal droppings, sap, and carrion. They have also been observed along the banks of Clear Creek and the roadside ditches sipping moisture from wet sand or soil. This inspired an attempt to lure butterflies to the garden by creating small areas of moisture. Four shallow holes, approximately one meter in length and one half meter in width, were placed at the edges of the garden. Each was lined with plastic, covered with soil, and watered. In June, peat was added to the mud to aid in retaining moisture.

Results

Table 3 illustrates the plantings of the butterfly garden. "T" represents young plants which were transplanted from the wild, "S" represents plants which were planted indoors from seeds, then transplanted to the garden, "Y" applies to young plants taken from other gardens, and "I" represents immigrant weeds which were allowed to gain a foothold in the garden. The plants which succeeded in attracting butterflies, and the butterflies which were observed feeding (F) or resting (R) on the foliage, are included in Table 4. Observations of certain insects other than Lepidoptera are included.

The first set of puddles constructed, failed to retain adequate moisture and required daily watering. Butterflies were not observed at these puddles. In June, peat was mixed with mud and did not require daily watering to retain moisture. Several species of butterflies were observed at the second set of mud puddles in the garden. These included Nymphalis antiopa, Polygonia interrogationis, Polygonia sp. (Figure 1), Epargyreus clarus, Vanessa atalanta, Everes comyntas (Figure 2), Limenitis arthemis astanax, and Poanes sp.

TABLE 3. Plants of the Barnebey Butterfly Garden with "T" representing young transplants from the wild, "Y" representing young plants taken from other gardens, "I" applying to immigrant weeds, and "S" representing the plantings from seeds.

Plant	Method of Introduction
Polygonatum biflorum	T
Lychnis chalcidonica	S
Aquilegia canadensis	S
Nasturtium sp.	S
Fragaria virginiana	I
Apocynum cannabinum	I
Lysimachia quadrifolia	T
Verbena sp.	S
Dracocephalum virginianum	Y
Salvia officinalis	Y
Thymus sp.	Y

TABLE 3. (continued)

Plant	Method of Introduction
Cunila origanoides	S
Penstemon hirsutus	T
Digitalis purpurea	S
Erigeron philadelphicus	T
Anthemus sp.	T
Centaurea cyanus	Y
Buddleia sp.	Y
Salpiglossis grandiflora	S
Zinnia sp.	S
Molucella laevis	S
Quamoclit sloteri	S

TABLE 4. Garden plants which succeeded in attracting butterflies and flower-feeding insects. Activity of insect indicated by "F" for feeding or "R" for resting.

Plant	Insect	Activity
Saxifraga virginiensis	Elateridae	F
Potentilla simplex	*Limenitis archippus*	R
Trifolium pratense	*Epargyreus clarus*	F
Melilotus alba	*Epargyreus clarus*	F
	Everes comyntas	F
Viola sp.	*Epargyreus clarus*	F
Melilotus sp.	*Polygonia interrogationis*	R
Phlox divaricata	Bombyliidae	F
Myosotis scorpiodes	*Epargyreus clarus*	F
	Poanes sp.	
Eupatorium dubium	*Limenitis archippus*	R

TABLE 4. (continued)

Plant	Insect	Activity
Valerianella olitoria	*Euptychia cymela*	F
Erigeron annuus	*Epargyreus clarus*	F
Echinacea purpurea	*Boloria toddi*	F
	Papilio glaucus	F
	Papilio troilus	F
	Hemaris sp.	F
Rudbeckia sp.	*Danaus plexippus*	F
Chrysanthemum leucanthemum	*Boloria toddi*	F
Achillea millefolium	*Everes comyntas*	F
Senecio aureus	Elateridae	F
Taraxacum officinale	*Boloria toddi*	F
Antirrhinum sp.	*Speyeria cybele*	R
	Papilio glaucus	R
	Papilio troilus	R

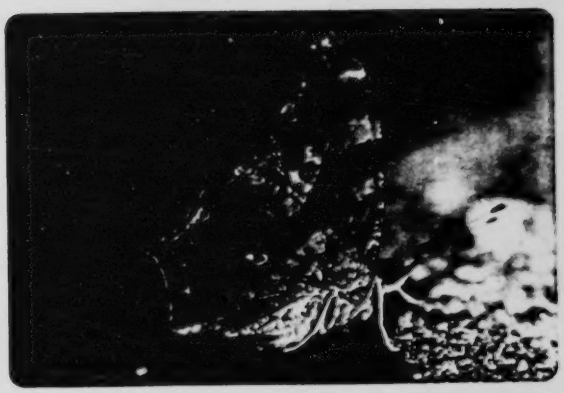

Fig. 1. Polygonia sp., a frequent visitor to the puddles of the butterfly garden.

Fig. 2. Everes comyntas engaged in sipping moisture from wet sand or soil. The activity is known as forming mud puddle clubs.

Discussion

Throughout the growing season, three major events influenced activity at the garden. In early May, two days of frost destroyed several plants. Later, there was a period of drought. Peat was added to retain moisture. According to the monthly water Inventory Report for Ohio, May, 1977, Central Ohio experienced 7.96 inches below normal precipitation for the eight months preceeding May and received less than one inch of rain during May. The third major event which influenced the garden was the destruction of many of the plants by rabbits and groundhogs.

It cannot be concluded that the plants listed in Table 3 are nectar sources. Therefore they should be considered experimental flowers. Some are available commercially. Native wild plants however, are very desirable as attractant plants. Their use should be promoted, particularly since they are part of the landscape's native flora. Acquiring native species may involve collecting seeds from vacant lots, roadsides, or railway right of ways. Within urban areas, allowing woodlots and embankments to grow up to natural plant cover will attract the native butterflies.

Several plants listed in Table 3 are recognized as butterfly attractants although they did not flower at

Barnebey. Buddleia sp. and Dracocephalum virginianum deserve attention. According to Taylor (1961), Buddleia sp., butterfly bush, generally grows best in states south of Ohio. It can be acquired from southern states by mail order from several Ohio garden centers.

Dracocephalum virginianum, obedient plant, is commonly known to attract hummingbirds and butterflies. This was not observed at Barnebey since the plant bloomed after observations ceased.

The garden can be considered moderately successful since eleven garden plants succeeded in attracting sixteen butterfly species to feed. Nine of the plants were native wild plants and two were not (Table 4). Seven butterfly species were observed to use four species of the plants for resting but not for feeding. It is not known why butterflies were attracted to those four plants and did not feed. Any of the plants in the garden which did succeed in attracting butterflies should be considered when planning a garden.

If damp areas are to be included in plans for a

garden, they should be areas of natural moisture that do not require daily watering. The mixture of mud and peat, although not maintenance-free is simple and does attract some butterflies. Alternative methods, perhaps more elaborate might, likewise be successful attractants.

Observations of Feeding Butterflies at Nectar Sources

Introduction

According to Brewer (1977), little information is available on the food plants of more than 20,000 species of adult butterflies in the world. Klots (1951) and Howe (1975) have compiled extensive information on North American Lepidoptera yet include only the names of larval food plants. Clark (1932), Saunders (1932), Norris (1936) and Gilbert and Singer (1975), have made extensive field observations and contributed significantly to the knowledge of adult food sources. Adult butterfly foods however differ with sex, age, season, and biotype (Kulman: 1977). Only field observations will provide additional knowledge on the nectar sources of Ohio butterflies. This information may aid in the conservation of habitats, popularization of butterfly gardening for popular viewing, or studies of individual species.

Methods

During April to September, 1977, daily field observations were made in the area of the Barnebey Center. Plants observed to be nectar sources were recorded. As each wildflower bloomed, it was observed throughout the day to determine the extent of its use by butterflies.

Results

Fifty-one species of plants beyond the garden were observed to be nectar sources for twenty-three species of butterflies present in the Clear Creek Valley. Thirty-five of the plants were most abundant on dry or well-drained sites and sixteen were found in wet sites. Included in Table 5 is the bloom period of each plant. One moth genera (*Hemaris sp.*) is included because its members feed diurnally and are often encountered (Figure 3).

Discussion

In planning for butterfly management, consideration should primarily be given to the terrain. A combination of desireable plants could be then selected to suit the available sites. Those selected should have overlapping bloom periods. This insures that some nectar sources will

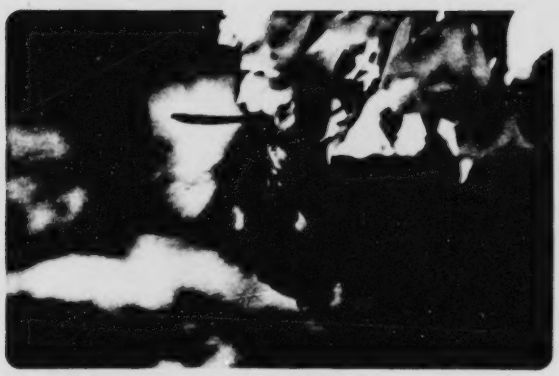

Fig. 3. Hemaris sp., a diurnally feeding hawkmoth often encountered in the Clear Creek Valley. Here it feeds on nectar of Mertensia virginica.

TABLE 5. Nectar sources of the Clear Creek Valley Butterflies, their bloom periods and the butterflies attracted.

Plant	Site	Bloom Period	Butterflies
Allium vineale	Dry	May through July	*Speyeria aphrodite*
Saponaria officinalis	Dry	July through Sept.	*Papilio troilus*
Barbarea vulgaris	Dry	April to August	*Boloria toddi*
Gillenia stipulata	Dry	May through July	*Papilio marcellus*
Potentilla simplex	Dry	April to June	*Limenitis archippus*
Rubus sp.	Dry	May to July	*Papilio polyxenes* *Papilio troilus* *Vanessa atalanta*
Trifolium pratense	Dry	June to Aug.	*Danaus plexippus* *Boloria toddi* *Speyeria atlantis* *Everes comyntas* *Papilio troilus* *Epargyreus clarus* *Atrytone ruricola*
Melilotus alba	Dry	May to Oct.	*Everes comyntas* *Epargyreus clarus*

TABLE 5. (continued)

Plant	Site	Bloom Period	Butterflies
Lathyrus latifolius	Dry	June to Sept.	*Speyeria cybele* *Papilio troilus* *Epargyreus clarus* *Hemaris sp.*
Oxalis europaea	Dry	May to Oct.	*Phyciodes tharos*
Geranium maculatum	Dry	April to June	*Papilio troilus*
Aesculus glabra	Dry	April through May	*Papilio glaucus*
Viola sp.	Dry	April to June	*Everes comyntas*
Lythrum salicaria	Wet	June to Sept.	*Papilio troilus* *Epargyreus clarus* *Pieris rapae* *Hemaris sp.*
Pastinaca sativa	Dry	May through Oct.	*Strymon falacer*
Cornus florida	Dry	March to June	*Lycaencpsis argiolis*
Daucus carota	Dry	May through Oct.	*Colias philodice* *Danaus plexippus*

TABLE 5. (continued)

Plant	Site	Bloom Period	Butterflies
Apocynum cannabinum	Dry	June to August	Speyeria cybele Atrytone ruricola
Asclepias tuberosa	Dry	June to Sept.	Boloria toddi Phyciodes tharos Limenitis arthemis Papilio troilus
Asclepias amplexicaulis	Wet	May through July	Danaus plexippus Speyeria cybele Speyeria aphrodite
Asclepias incarnata	Wet	June to Aug.	Danaus plexippus Speyeria cybele Papilio troilus Hemaris sp.
Polymonium van-bruntiae	Wet	June to July	Papilio troilus
Phlox maculata	Wet	May to June	Polygonia interrogationis Papilio glaucus Papilio troilus Hemaris sp.
Myosotis scorpiodes	Wet	May to Oct.	Everes comyntas

TABLE 5. (continued)

Plant	Site	Bloom Period	Butterflies
Mertensia virginica	Wet	April and May	*Hemaris sp.*
Scutellaria incana	Dry	June to Sept.	*Papilio troilus* *Hemaris sp.*
Prunella vulgaris	Dry	May through Aug.	*Boloria toddi* *Phyciodes tharos* *Papilio troilus* *Epargyreus clarus*
Stachys palustris	Wet	July through Aug.	*Papilio troilus* *Papilio polyxenes*
Monarda fistulosa	Wet	July through Aug.	*Speyeria cybele* *Speyeria atlantis* *Polygonia interrogationis* *Papilio troilus* *Epargyreus clarus* *Limenitis arthemis* *Hemaris sp.*
Penstemon sp.	Dry	May to July	*Papilio troilus*
Mimulus ringens	Wet	June to Aug.	*Papilio troilus*

TABLE 5. (continued)

Plant	Site	Bloom Period	Butterflies
Liatris aspera	Dry	Aug. to Sept.	*Speyeria atlantis* *Papilio glaucus* *Papilio troilus* *Epargyreus clarus*
Veronicastrum virginicum	Wet	June to Sept.	*Boloria toddi* *Phyciodes tharos*
Valerianella ditoria	Dry	May	*Euptychia cymela*
Campsis radicans	Dry	July through Aug.	*Papilio troilus*
Cephalanthus occidentalis	Wet	June through July	*Boloria toddi* *Speyeria cybele* *Speyeria atlantis* *Phyciodes tharos* *Papilio troilus* *Papilio glaucus* *Epargyreus clarus* *Hemaris sp.*
Lonicera japonica	Dry	April to July	*Papilio glaucus*
Vernonia novaboracensis	Wet	August to Oct.	*Danaus plexippus* *Boloria toddi* *Speyeria cybele*

TABLE 5.(continued)

Plant	Site	Bloom Period	Butterflies
			Speyeria atlantis Papilio philenor Papilio glaucus Papilio troilus Colias philodice Epargyreus clarus
Eupatorium perfoliatum	Wet	July through Sept.	Danaus plexippus Phyciodes tharos Speyeria cybele Epargyreus clarus Limenitis arthemis
Eupatorium maculatum	Wet	July through Sept.	Danaus plexippus Boloria toddi Speyeria cybele Speyeria atlantis Speyeria aphrodite Papilio glaucus
Rudbeckia laciniata	Wet	July to Oct.	Phyciodes tharos
Rudbeckia hirta	Dry	June through Oct.	Phyciodes tharos Vanessa virginiensis
Echinacea purpurea	Dry	June to Oct.	Phyciodes tharos Speyeria cybele

TABLE 5. (continued)

Plant	Site	Bloom Period	Butterflies
			Everes comyntas Papilio troilus Papilio glaucus Epargyreus clarus Hemaris sp.
Helianthus sp.	Dry	Aug. to Oct.	Phyciodes tharos
Ratibida pinnata	Dry	June	Phyciodes tharos
Achillea millefolium	Dry	June to Oct.	Epargyreus clarus
Anthemus catula	Dry	June to Oct.	Phyciodes tharos
Chrysanthemum leucanthemum	Dry	April to Sept.	Danaus plexippus Boloria toddi Lycaena phlaeas Vanessa atalanta
Cirsium arvense	Dry	July to Sept.	Speyeria cybele Vanessa cardui Epargyreus clarus
Cirsium discolor	Dry	July to Oct.	Speyeria cybele Papilio polyxenes Papilio troilus Papilio glaucus Epargyreus clarus

TABLE 5. (continued)

Plant	Site	Bloom Period	Butterflies
Taraxacum officinale	Dry	April to Sept.	*Boloria toddi* *Papilio glaucus* *Papilio troilus*

always be available during the flight season.

Most of the plants and butterflies listed in Table 5 are rather widely distributed and the information gained in this study should be applicable in attempts at management in many areas.

The Census

Introduction

As no formal records of the Lepidoptera of the Clear Creek area are available, it was apparent that accumulating a species list, as an index to population would be essential. This practice, employed often in ornithology, is recommended by the Xerces Society, an international non-profit organization established for the conservation of terrestrial arthropods and their habitats. The census approach furnishes valuable qualitative information on distribution and fluctuations of butterfly populations (Pyle: 1976). In addition, the count is a tool to increase community awareness of butterflies and their needs.

The Xerces Society recommended a count period from late June to July 17th to include flight periods of spring and high summer species. To study populations over several years, it is necessary to have a standard sized area and to compensate mathematically for variation in the amount of time spent counting from year to year. The variables are the species diversity and abundance (Hathaway: 1977).

Methods

A fifteen mile diameter circle, thought to be uniform in soil and vegetation types, was established from which to select habitats for the count. The area included Clear Creek winding through the center of the area, west to the Pickaway-Fairfield County line, east to State Route 33, north to Route 752, and south to Route 100. The habitats included the old field at the north curve of Barnebey Road south of the junction of Revenge and Barnebey Roads, Barnebey's prairie, 8.5 km. west of Route 33 on Clear Creek Road, the roadside at Lake Ramona and an old field 0.5 km. west of the Barnebey Center. Also included were a broomsedge meadow, a willow bottomland, an oak-hickory ridgetop, and a wet sedge meadow of Camp Wyandot, 4.7 km. west of Route 33. At the Wahkeena

Preserve, 9.5 km. south of Lancaster off Pumping Station Road, a meadow of Joe-Pye-Weeds, a grassy roadside, and dike were selected for sampling. At Geneva Hills, 10.75 km. south of Lancaster on Blue Valley Road, a mixed-mesophytic slope and a swath were sampled. Finally, the Muddy Prairie area, commonly known as Amanda Bog, 1 km. north of Amanda off Route 22, was sampled. A map of these locations can be found in the Appendix in A Guide to July Butterfly-Wildflower Observing in Ohio's Clear Creek Valley and Several Adjoining Areas.

The percent coverage of the area censused was determined by marking the area on a geological survey map, dividing it according to habitat type, drawing a grid over the map and counting the squares in each habitat multiplied by 100 and divided by the total number of squares equaled the percent area taken up by that habitat. The coverage of area surveyed yielded the following habitats:

oak-hickory ridgetop	14.1%
wet sedge meadow	0.5%
broomsedge meadow	31.0%
willow bottomland	5.6%
muddy prairie (bog)	28.2%
roadside-old field	16.9%
dike and roadside	1.6%
Joe-Pye-Weed meadow	0.5%
gas pipeline swath	1.1%

Calculations for time spent and distance covered in the field are expressed in party hours and party miles. For example, if ten observers split into two parties the first hour, one large party the second hour and four parties for three more hours, a total of fifteen party hours would have been spent. The first hour would count as two party hours (2 parties X 1 hour), the next hour as one party hour (1 party X 1 hour), the next three hours with observers in four parties as 12 party hours (4 parties X 3 hours). If these parties covered two and one miles the first hour, two miles the second hour and three, two, three, and four miles the next three hours, a total of seventeen (=2+1+2+3+2+3+4) party miles would have been traveled. If the first hour were to be covered by car, the ten observers in one to four parties would have spent fifteen party hours (13 on foot, 2 by car) outside with a total of seventeen party miles (14 on foot, and 3 by car) (Hathaway: 1977).

On July 9th, from 1130 to 1430 hours and on July 10th, from 0930 to 1530 hours, seven participants worked in the field under hazy, cloudy skies with intermittent rain and temperatures of 20°C. The seven participants in one to two parties covered thirty-nine party miles (2 on foot, 37 by car), with a total of seven party hours (1½ on foot,

1½ by car. Each was equipped with an aerial sweep net, glassine envelopes, binoculars, field data sheets, field guides to butterflies, wildflowers, trees and a packsack.

During observations with binoculars (O), verbal communication with one another helped in preventing butterflies from being counted more than once. The use of binoculars greatly increased the numbers positively identified in a day. Larger species did not need to be captured because even the sex could be identified at a distance. Energy could be directed to the smaller, less conspicuous species. Netted (N) butterflies were placed alive within glassine envelopes or saved for identification later. Release of live butterflies from a central point can avoid duplication in collecting individuals. Some species were collected (C) for study.

Results

163 butterflies representing twenty-three species were discovered in nine different habitats. Although the day was overcast, the number represents quite a diversity (Table 6). The diversity index was calculated to be 1.34 using the formula, $H' = -\Sigma pi \log_e Pi$, where P equals the proportion of species i in the community and H equals the species diversity (Price: 1975).

TABLE 6. Species of butterflies encountered on the census. "O" represents observed at a distance, "N" means netted then released, and "C" represents collected for study. Species are listed according to the habitat in which they were found.

Habitat	Number	Method of I.D.
Broomsedge Meadow		
Euptychia cymela	6	2(C), 4(O)
Speyeria cybele	2	(O)
Boloria toddi	4	2(O), 2(C)
Phyciodes tharos	15	8(C), 4(O), 3(N)
Lycaena phlaeas	5	(C)
Everes comyntas	5	3(C), 2(O)
Colias philodice	1	(C)
Pieris rapae	2	1(C), 1(O)
Willow Bottomland		
Euptychia cymela	1	(C)
Boloria toddi	6	(C)
Phyciodes tharos	3	(O)
Vanessa atalanta	1	(O)
Everes comyntas	2	(C)
Papilio glaucus	1	(O)

TABLE 6. (continued)

Habitat	Number	Method of I.D.
Sedge Meadow		
Boloria toddi	1	(O)
Vanessa virginiensis	1	(C)
Oak-Hickory Ridgetop		
Euptychia cymela	2	(O)
Papilio philenor	3	2(C), 1(O)
Papilio troilus	3	(O)
Pieris rapae	3	(O)
Muddy Prairie (bog)		
Phyciodes tharos	2	(O)
Polygonia sp.	1	(O)
Pieris rapae	11	6(C), 5(O)
Pholisora catallus	2	(C)
Ancyloxpha numitor	3	(C)
Joe-pye-weed Meadow		
Speyeria cybele	1	(O)
Vanessa atalanta	1	(O)

TABLE 6. (continued)

Habitat	Number	Method of I.D.
Papilio glaucus	1	(O)
Epargyreus clarus	1	(O)
Barnebey Roadside and Old Field		
Euptychia cymela	9	4(C), 5(O)
Danaus plexippus	2	(C)
Phyciodes tharos	2	1(C), 1(O)
Polygonia sp.	4	(O)
Polygonia interrogationis	3	(C)
Vanessa atalanta	1	(O)
Limenitis arthemis	5	(O)
Everes comyntas	1	(C)
Lycaenopsis argiolus	1	(C)
Papilio glaucus	7	1(C), 6(O)
Papilio philenor	7	5(C), 2(O)
Colias philodice	1	(C)
Pieris rapae	2	(O)

Table 6. (continued)

Habitat	Number	Method of I.D.
Swath		
Euptychia cymela	1	(C)
Cercyonis pegala	2	1(C), 1(O)
Phyciodes tharos	3	1(C), 2(O)
Everes comyntas	1	(C)
Papilio troilus	8	2(C), 6(O)
Epargyreus clareus	1	(C)
Grassy Dike and Roadside		
Phyciodes tharos	1	(O)
Limenitis arthemis	2	(O)
Strymon falacer	1	(C)
Lycaenopsis argiolus	4	(O)
Papilio glaucus	2	(O)
Papilio philenor	1	(O)
Papilio troilus	1	(O)
Colias philodice	1	(O)
TOTAL	163	

Fig. 4. Echinacea purpurea or Purple coneflower. Blooming June to October, it attracts many species of butterflies.

Fig. 5. Asclepias tuberosa or Butterfly Weed grows in dry, open sites.

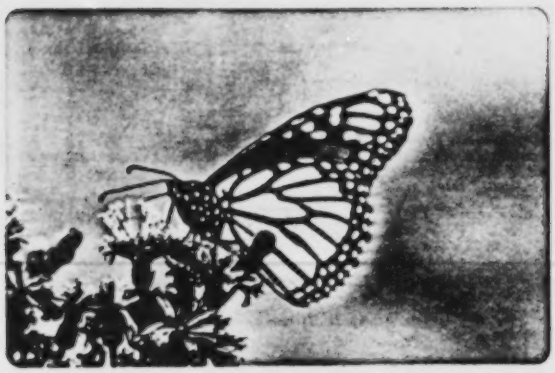

Fig. 6. Vernonia novaboracensis or New York Ironweed blooms in autumn and serves as a nectar source for many species of butterflies. The Monarch, Danaus plexippus, feeds at the flower.

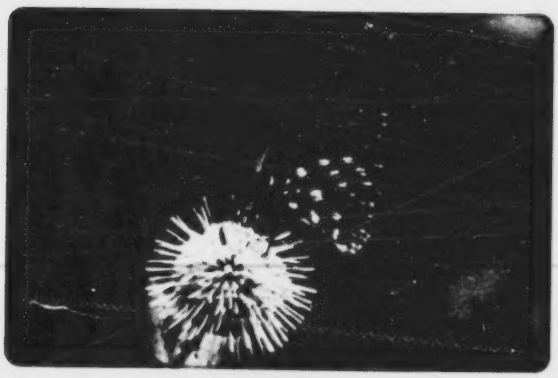

Fig. 7. Speyeria cybele, the Great Spangled Fritillary butterfly is attracted to Buttonbush blossoms, Cephalanthus occidentalis. The plant is a wet site species.

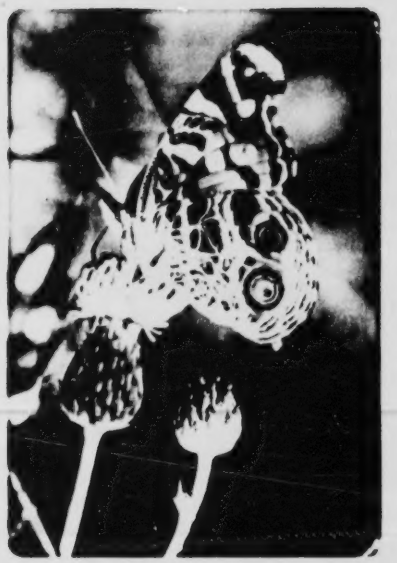

Fig. 8. Vanessa virginiensis, the American Painted Lady, is identified by the two large spots beneath the hindwing. Butterflies of this genus commonly feed at thistles.

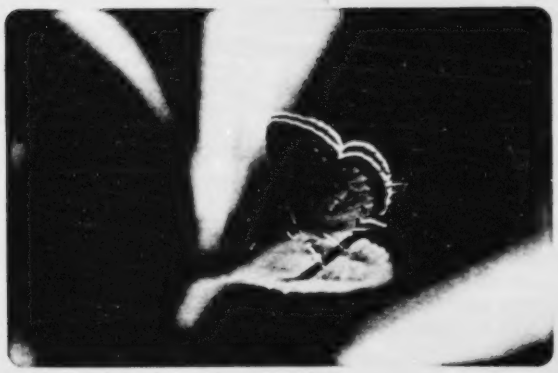

Fig. 9. The Eastern Tailed Blue, Everes comyntas, has been observed to feed at White Clover, Violets, For-Get-Me-Nots, and Coneflowers.

ANTS AND PLANTS

Introduction

The ant, Formica fusca, will travel distances up to twenty-six feet in search for food (Pickles: 1935). It also will feed at plants posessing floral and extra-floral nectaries (Goetsch: 1969) (Elias: 1972). Nectaries are nectar-exuding structures on some plants and are not associated with pollination. They have been discovered in the families of Leguminosae, Bignonaceae, Sterculeaceae, Turneraceae, and Passifloreaceae (Elias: 1975). Studies of plants possessing nectaries have centered around botanical specimans of more tropical areas. According to Elias (1977) some midwestern plants bear nectaries. These plants include:

Passiflora incarnata-Passion Plant
Campsis radicans-Trumpet Creeper
Cassia fasciculata-Partridge Pea
Cassia nicitans-Wild Sensitive Plant
Catalpa speciosa-Catalpa
Albizia julibrissin-Silk Tree
Ailanthus altissima-Tree-of-Heaven
Prunus serotina-Wild Black Cherry
Prunus virginiana-Choke Cherry

The objectives of this project were (1) to locate nectary-bearing plants in the field, (2) to locate a

colony of Formacine ants, (3) to plant nectary bearing plants near an ant colony, and observe the behavior and movement of the ants during foraging at the nectaries, (4) to gather new information about ants on temperate zone nectary plants and (5) to maintain plantings of nectary bearers located so that foraging ants would provide prey for an ant lion colony.

Methods

Time was spent in the field searching for the ant Formica fusca. A search for nectar bearing plants was also conducted. When the plants were located they were transplanted to within eight meters of the ant colony and watered during dry periods.

The first plant discovered, Vicia sativa, was particularly attractive to the ants. However, no reference was found in the literature regarding the possession of nectaries. For that reason, the behavior of the ants on the plants was carefully observed. The aggressive action of the ants towards intruders was observed by placing various arthropods upon the leaves of V. sativa. The reaction of ant and intruder was recorded. The results appear in Table 7. Thirty-two plants were examined in late June for determining the average number of nectar exuding stipules.

TABLE 7. Ant reaction to introduction of arthropods on *Vicia sativa*.

Introduced Arthropod	Ant Reaction	Result of Encounter
Spider (abdomen 5mm. in diameter)	Ant rushed upon it and bit spider	Spider dropped to ground
Harvestman	Ant lunged and bit repeatedly	Harvestman dropped to ground
Japanese beetle	Ant attacked it and bit it repeatedly	Beetle clung to leaf for 15 seconds then dropped to ground
Adult damselfly	Ant lunged at it	Damselfly flew
Spider (abdomen 2mm. in diameter	Ant left aphid-tending to rush at spider	Spider dropped to ground
Spider (1 cm. in diameter)	Ant lunged at spider	Spider dropped to ground
Red ant from nearby colony	Ant attacked it and fight ensued	Both ants fell to ground
Fly glued to leaf	Ant rushed at it, retreated, lunged again and again	Ant returned to feeding at a nectary, often returning to bite fly
Immature and Adult Aphids	Ant palpated it with antennae	Aphids remained on plants

The movement of the ants was observed in the following manner: Seventy-three ants on forty plants were painted with a spot of white acrylic paint as they fed at the nectaries. The number of painted ants and unpainted newcomers were counted four times daily for four days. On the ninth day following painting, ants were again counted. A total of eighteen periods of observation took place. Temperatures also were recorded.

On May 15th, a stem cutting from Passion Plant (Passiflora incarnata)was planted beside the ant lion shelter. The selected site was well-suited to the vine because it grows in dry sunny places.

On June 19th, 102 Partridge Pea plants (Cassia fasciculata and Cassia nicitans) were transplanted to the area around the ant lion colony.

In late May, three branches of Trumpet Creeper (Campsis radicans), each exceeding 1.5 meters in height, were transplanted to the same area.

Snapdragons (Antirrhinum sp.) were also purchased and planted near the colony.

Results

In mid-May two Formacine ant nests were found among old field vegetation. An ant lion colony was established within two feet of the ants.

Vicia sativa, a plant with nectaries, was growing within seven to nine meters of the ant colony. The other plants in the area included Apocynum sp., Circium sp., Solidago sp., Desmodium sp., Daucus carota, Barbarea vulgaris, Dianthus armeria, Viola sp. Allium vineale, Anemone virginiana, Glechoma hederacea, Erigeron annuus, Erigeron philadelphicus, Gallium sp., Chrysanthemum leucanthemum, Sisgranchium sp. The Vicia sativa plants between sixty to eighty-three cm. in size were the plants which produced the most active nectaries (Fig. 10)(Table 8).

The nectaries were located on the underside of paired stipules. They appeared deep maroon to almost black when exuding nectar. The outline and color of the nectaries was apparent through the thin upper surface of the stipules. As they exuded less, the color changed to pale red, often with a white spot in the center (Fig. 11). All stipules were about the same size. Nectaries varied from egg to tear-drop shaped, but all were found to occupy the ear of the stipule. Not all stipules contained nectaries. Occasionally, some were lacking on stipules near the ground. If one stipule of a pair possessed a nectary, the other also did. Large nectar drops developed at flowers or developing seed pods, rather than at mature pods. The nectary closest to a pod or flower was a deep maroon color. By the end of the

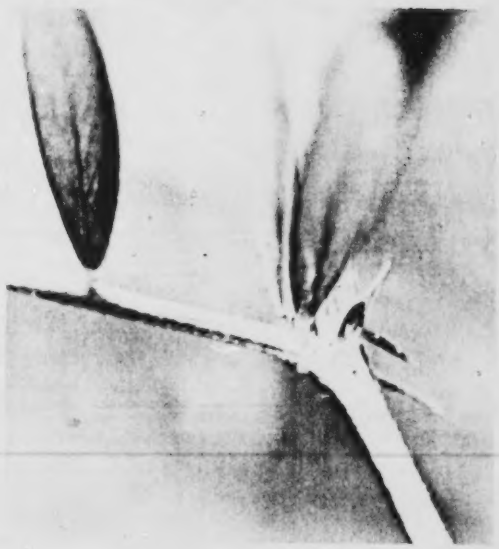

Fig. 11. As a nectary exudes less nectar, there often appears a white spot in the center.

TABLE 8. Sizes of *Vicia sativa* in centimeters and average number of nectaries.

Height in Cm.	Number of Plants	Average Nectary Number
36-46	8	16
48-59	9	16
60-71	9	18
72-83	4	22
84-95	2	20

Fig. 12. The typical feeding position of a Formacine ant at an extra-floral nectary of Vicia sativa.

fourth day of observations, some plants had past anthesis, developed seed pods and were wilting. Some plants continued to bloom into August.

As ants foraged at the Vicia sativa, they were continually moving. Observations of the ants revealed that the ants spent sixty-two percent of their time moving about the stems, eight percent on the pods, and six percent upon leaves. The typical position of an ant during nectar foraging at V. sativa is illustrated in Figure 12.

Figure 13 illustrates the percent of marked ants recovered on V. sativa in relation to time since marking. Recovery of marked ants declined considerably between the day they were painted and the following day. Ants were never seen on the plants during the night. During the observations, the temperatures ranged from 20°C. in the A.M. to 30°C. in the afternoon.

Table 7 summarizes the results of observing ant aggression towards intruders. In each case, the ant (Formicine) was successful in guarding the plant and causing the intruder to withdraw.

During May, the plant Passiflora incarnata, had survived a late frost. By mid-June, it appeared healthy and revived. It grew to be three meters in height. Although the species usually blooms throughout June and

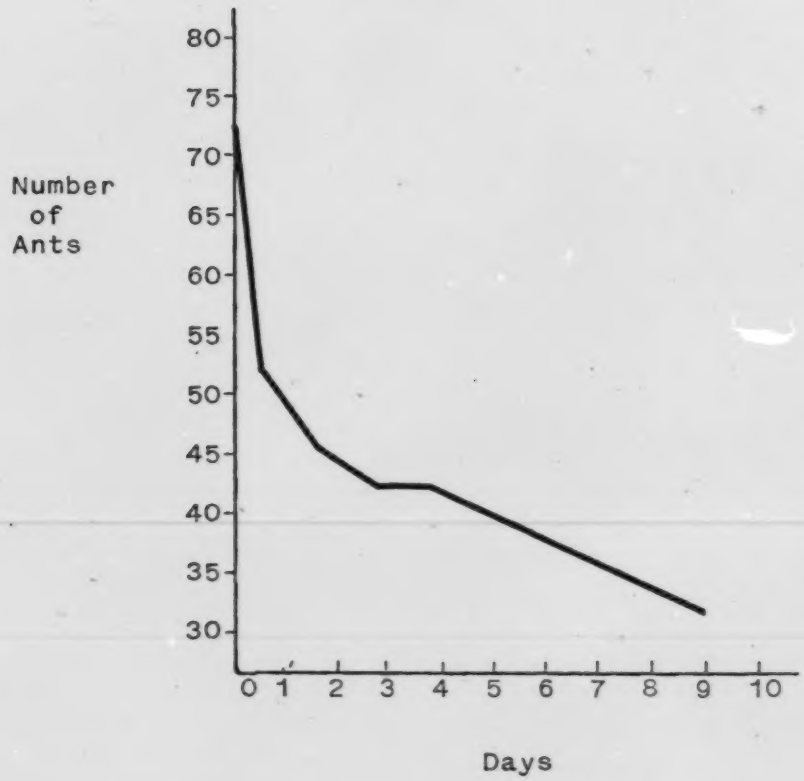

Fig. 13. Percent marked ants recovered on Vicia sativa in relation to time since marking.

July, that did not occur.

Small knobs on the leaf pedicels of P. incarnata attracted several species of insects. A Myrmacine ant appeared daily on the leaves and stems but did not guard the nectaries. When Formacine ants approached the plants, the Myrmicine ant would flee. No Formacine ants were observed feeding at the nectaries. An orthopteran, Phylopalpus pulchellus, the Handsome Bush Cricket was collected from a nectary of the plant. Myrmacine and Formacine ants were observed at the tiny black nectaries accompanying each compound leaf of Cassia sp. The ants did not appear regularly or in large numbers. The greatest number of nectaries existing on one plant was fourteen on a plant which was 10.16 centimeters in height. Most plants had four to eight nectaries. Some plants bloomed into August and attracted ants. The Myrmacine ants were not aggressive. They moved away from a nectary if another species approached. However, Formacine ants did not remain feeding at the nectaries.

Campsis radicans did not bloom nor were ants seen on the transplanted plants. In mid-July, a blooming Campsis plant was found. It was tended by Formacine ants. The nectaries were not easy to see because they were so minute. The ants did not flee when disturbed.

They aggressively defended the plant in much the same manner as on V. sativa.

The solitary flowers in terminal racemes of Antirrhinum sp. bloomed from June through August. Only one Formacine ant was ever discovered on the plants. It was discovered enclosed within a flower.

Discussion

When managing for Formacine ants, it is suggested that V. sativa be planted. The seeds are easily collected from the mature pods and can be broadcast early in spring of the following year. The plants will then bloom from early May to August. Seeds are also available commercially since the plant is used as a cover crop in orchards. If seeds are collected it should be done from medium-sized plants. The largest plants do not necessarily produce the larger amounts of nectar.

V. sativa has many visible nectaries per plant and several ants can be observed simultaneously. One might speculate that the production of nectar by the plant is useful as an ant attractant system in which the ants effectively protect the flowers and developing fruit from harmful insects. Painted ants were recovered on the days following marking, but never at night on the plants, but it is not known whether they remained beneath the plants at night or returned to the colony. If the

foragers returned, they may have recruited unmarked ants to the plants. A decline in the number of ants recovered by the ninth day may be related to the decline in active nectaries available although it is not discernable from the available data. The continual movement of ants on and off V. sativa is an important factor when considering managing a colony of ants as prey for a stationary insect. The merits of this idea will be discussed in a following section.

More observations at Passiflora incarnata might reveal that the Formacine ants would be attracted to more nectaries of a taller plant or one which produces bloom (Fig. 14).

The two species of Cassia did not attract the Formacine ants as successfully as did V. sativa. The nectaries were far smaller and difficult to observe. Since the bloom period overlaps with that of V. sativa, it need not be used where the ranges of the two plants overlap.

Although the nectaries of Campsis were minute, the plant should be considered in planning for ant management. The aggressive behavior, again, was observable and varied.

Taylor (1961) states that ants will feed extensively on seeds of Antirrhinum sp. until they germinate. Although the plants near the colony succeeded in attracting only one Formacine ant, the plant could be useful as a backup

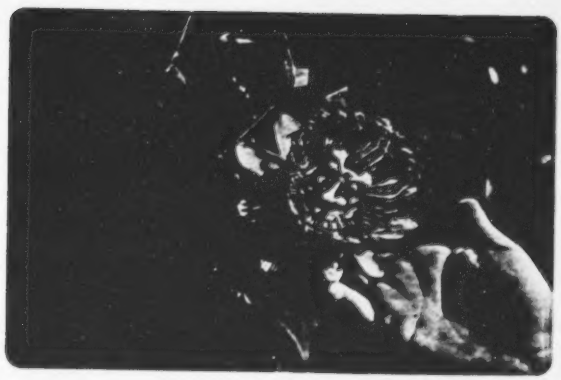

Fig. 14. Passiflora incarnata, or Passion Plant, is a tendril-bearing vine which blooms in June and July. The plant is known to bear nectaries.

food source, if other plants failed to bloom.

ANT LIONS

Introduction

The larvae of the common North American ant lion, (Figure 15) Myrmeleon immaculatus, were selected for this project because 1) they were expected to remain in a limited area for one to two years (Kennedy: 1960), 2) they are abundant throughout the state, and 3) they are predacious and active within a small area. They are described by H.L. Moody in this way:

> "In the larval state it is certainly in some respects the most interesting insect I have ever seen, its very activity and pugnacity exiting admiration: its mandibles were always ready to close upon any intruding object."

The life cycle has been described by Kennedy (1960) as beginning when eggs are deposited in sand during summer and early fall. Larvae hatch in late summer and fall. All three of the developmental stages of the larvae overwinter and occur throughout the year. Pupation occurs in spring and early summer. Adults emerge in early summer until late summer. During winter, if the temperature of the soil or sand warms past the threshold for activity, pit excavation and trail making may occur.

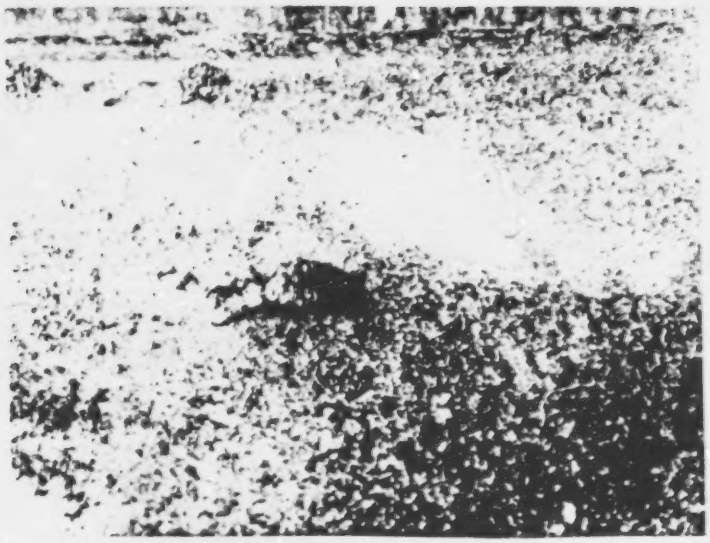

Fig. 15. The mandibles of the common North American ant lion, Myrmeleon immaculatus, were always ready to close upon any intruding object.

The pits constructed by the larvae function in two ways. The first is as a trap in which the ant lion will lie in wait for prey, then toss sand into the air. The prey then falls into the pit and is snatched by the ant lion. The second function of the pit-trap is to allow the larvae to avoid the hot surface of the sand, providing a temperature gradient as the day becomes warmer (Green: 1955) The larvae can then find a position to maintain activity when surface temperatures become extreme.

The habitat of the ant lion larvae is small, isolated desert-like conditions. These can be found at Old Man's Cave, located in the northwest quarter of Section 14 in Benton Township. There, the ant lions are in loose dry soil, sheltered from wind and rain by rocky overhangs.

The food of Myrmeleon immaculatus usually consists of any arthropods which tumble into the pitfalls. The common black ant, Formica fusca, has been described by Green (1955) as active during the temperature-activity range of Myrmeleon immaculatus (between 10° and 34.5°C). This characteristic suggests that it could serve as a primary prey species for the ant lion.

The objective of the project was to establish an ant lion colony near an ant colony which would hasten

development from larvae to adult. The presence of any new pits, in a site far removed from other ant lion colonies, would indicate whether newly emerged adults had remained and oviposited. In addition, the ant lion colony needed to be placed near a colony of Formacine ants. The stationary existance of ant lion larvae often forces them to fast for long periods of time. The duration of the larval stage is dependant on the abundance of prey. Placement of the ant lions near the ants would certainly hasten their development from larvae to adult. This has significance when considering the establishment of insect areas along interpretive trails. Active insects which complete their life cycles within a restricted area could probably be maintained for visitors from year to year.

Methods

During April, 1977, two colonies of the ant Formica sp. were discovered among old field vegetation. On May 5, 1977, twenty-four ant lions, in various stages of development, were collected from Old Man's Cave. They were placed in 4.5 cm. deep sand on a board beneath a wooden lean-to shelter, constructed to provide protection from wind and rain (Figure 16). This insured loose sand for effective pit-traps. The shelter, located three to four meters from the ant colonies, was about one meter long

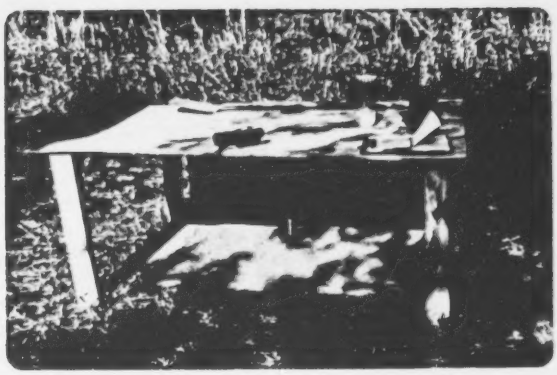

Fig. 16. A wooden lean-to shelter, constructed to protect the ant lion colony from wind and rain.

and one meter wide. The roof was set at a height of one meter.

During the succeeding months, ant lion pit construction and feeding behavior were observed. Insect exuviae were collected from the board at the rims of pits since they indicate that feeding activity took place.

Results

Exoskeletons were observed at the rims of pits and at distances of up to six inches from the nearest pit. Prey consumed from April 26th to June 6th by the ant lions included: thirty-nine ants in the genus Formica (74% of the total consumption), a variety of Coleoptera, Harvestmen (Order Phalangida), true bugs (Order Hemiptera), flies (Order Diptera), spiders (Order Araneida), and centipedes (Class Chilopoda). The total consumption was fifty-three arthropods. Although ticks were abundant, no exoskeletons were ever discovered. Ticks had been seen straying across the sand and falling into pits. Observation revealed that ticks were tossed out and not consumed. They usually continued to stray across the sand.

During May, the discovery of eleven empty pupal cases revealed that adult ant lions had emerged from the

colony. In early June, rodent disturbances took place. Evidence was in the form of footprints in the sand, droppings, and gnawed marks on the board. The ant lions reacted by movement of pits and trail-making (Figure 17). Loss of larvae occurred and many were thought to have fallen among the surrounding vegetation. More larvae were collected to increase the colony size to thirty-five. By June 27th, only twenty-three ant lions were present. Only three pupal cases were found. However, by August 3rd, forty-six tiny new ant lion pits riddled the sand. Each one contained a tiny larva.

Discussion

As the colony site offered the only suitable habitat for larval activity and oviposition in the area, it may be that the egg-laying females were those which had emerged from it. The total consumption of ants probably resulted in increased development from larvae to adult. Any efforts to increase ant foraging activity in the vicinity of the ant lion colony would certainly benefit the ant lions.

Considerations to development of display shelters for ant lions might take various forms. Attractive shelters can be fashioned from natural materials which might blend in with the surroundings. In Figure 18,

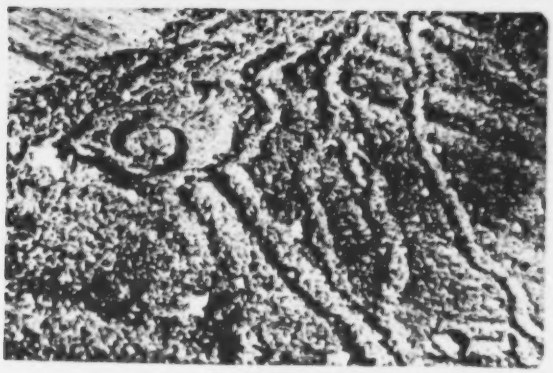

Fig. 17. Trail making and pit building of ant lion larvae.

colony. In early June, rodent disturbance took place. Evidence was in the form of footprints in the sand, droppings, and gnawed marks on the board. The ant lions reacted by movement of pits and trail-making (Figure 17). Loss of larvae occurred and many were thought to have fallen among the surrounding vegetation. More larvae were collected to increase the colony size to thirty-five. By June 27th, only twenty-three ant lions were present. Only three pupal cases were found. However, by August 3rd, forty-six tiny new ant lion pits dotted the sand. Each one contained a tiny larva.

Discussion

As the colony site offered the only suitable habitat for larval activity and oviposition in the area, it may be that the egg-laying females were those which had emerged from it. The total consumption of ants probably resulted in increased development from larvae to adult. Any efforts to increase ant foraging activity in the vicinity of the ant lion colony would certainly benefit the ant lions.

Consideration to development of display shelters for ant lions might take various forms. Attractive shelters can be fashioned from natural materials which might blend in with the surroundings. In Figure 18,

the top portion of a partially decayed beech log was cut out and prepared with a plexiglass inlay. It was then tilted over a colony of ant lions at the edge of a path. Casual passersby could observe pit building and feeding from the sides and through the window. (Figure 19).

Soil should be collected from the original habitat. Establishing ant lions near an ant colony, particularly of Formica fusca, enhances the opportunity for the ant lions to develop more quickly into adults because of the great number of available ants.

Fig. 18. A partially decayed Beech log was prepared with a plexiglass inlay for observing ant lion activity. This display discourages visitor disturbance of the insects.

Fig. 19. The log was tilted over a colony of ant lions. Adult lions should be considered when placement of the log is planned.

THE SUCCESSION OF INSECTS ON THREE DECOMPOSING LOGS

Introduction

Interpretors of Natural History often use the decomposing log to illustrate ecological concepts. School children often are asked to participate in these studies as part of ecology lessons. Decomposing logs are particularly popular because of their accessibility and the predictability of a diversity of resident plants and animals. Because the predominant animals of a decomposing log are arthropods, particularly insects, environmental educators could take more advantage of their presence.

The objective of the study was to learn what arthropod invaders, particularly insects, made use of the freshly cut logs. This did not include breaking apart the logs which would hasten decomposition and disturb the community.

Methods

On April 7th, 1977, several large-toothed aspens

(Populus grandidentata) and red maples (Acer rubrum) were felled as part of a wildlife habitat management program. Since the logs were allowed to remain on the forest floor, it was expected that insects would eventually begin to inhabit the logs. Observations and collections occurred at least twice a week until August. One year later, logs were again checked.

Results

During May, few permanent residents could be found associated with the logs. Those present, were concealed within spaces at the points where the tree had been cut. Geophilomorpha, the centipedes, predators of the log community,were discovered. Small black spiders, within webs of wood chips and silk,utilized the cavities. By mid-May, the bark on the red maple was peeling. A rainfall filled the stump with water. Syrphid fly larvae, known as rat-tailed maggots, were found within the hole.

By June 6th, two more holes were discovered at the end of the red maple log. From these, several Hymenopteran insects were observed exiting. On the same date, fungi were noticed for the first time. Flat bugs (Aratidae) also known as fungus bugs, were collected under loose bark. By June 8th, the dark-winged fungus gnats (Sciaridae)

appeared in tiny clusters in the vicinity of the fungus growths. They were collected in mid June. Other fungus feeding insects began to appear then, including the hump-backed flies (Phoridae) and barklice (Psocoptera).

Throughout the summer, peacock flies displayed their wings in a fan-like fashion on the surface of the logs.

Beetles (Coleoptera) were common at the logs and represented four families. In mid May the adult metallic wood-boring beetles(Buprestidae) appeared on the surfaces of the logs. Carabid beetles were discovered under the bark.

Adult Cerambycid and Lampyrid beetles were found on trunks and limbs of the logs. The iridescent green tiger beetle, Cicindela sexguttata, was observed preying upon resident Formacine and Myrmacine ants. One year later, two immature tiger beetles were discovered in burrows beneath the logs.

Finally in late June, click beetles (Elateridae) were observed on the logs.

Discussion

The initial act of being felled caused the trees to crack with radiating splits. The splits expanded, providing cavities for centipedes and small black

They were active predators throughout the summer.

Beetles of the family Buprestidae are known to gather in the sun on trees on which they breed. They are known to feed at flowers. The larvae dwell within decaying trees. One year after the beetles were observed on the log, larvae were discovered.

The presence of the rat-tailed maggots demonstrated that the adult Syrphid flies might be seen in late April, May, or June. Collecting samples in water at tree stumps could reveal other kinds of larvae. The presence of the water contributed to further deterioration of the cavity.

In early June, fungus growths appeared on the logs. Concomitantly, the flat bugs (Aratidae) were discovered. They are known to feed on sap of fungi or moist rotting wood. Adult dark-winged fungus gnats (Sciaridae) also appeared. The larvae are generally known to live within fungi or decaying plants. Other fungus feeders such as the small soft-bodied Psocoptera were found near fungus growths and the lichens on the decaying logs.

The picture-winged flies (Tephritidae) were easily observed while displaying upon the logs.

The predaceous larvae of Carabid beetles were never discovered.

Slugs were observed at the logs in June. Since

according to Dillon (1977), click beetles are predaceous on slugs, there may be a relationship between the presence of both at the logs in June.

Since immature tiger beetlae were discovered beneath the logs, the habitat may be suitable for introducing a number of them for observation. More discussion related to these beetles is included in another section.

The food habits of the click beetles (Elateridae) are apparently not very well known (Dillon: 1977) but some were previously discovered on various wildflowers near the logs. The immatures known as wireworms, might have been found if the logs had been torn apart. This was not considered to be desireable however, as it might have altered the successional pattern of insects.

Although the successional patterns of insects in or on decomposing logs may vary slightly from region to region and from tree species to tree species, one may expect to discover many of the same common insects. The information provided in this study may be useful in planning interpretation of decomposing logs with emphasis on insect natural history.

TABLE 9. Invertebrates of three decomposing logs with emphasis on insects. "I" refers to itinerants, "O" refers to an insect which feeds on other wood products such as sap, leaves, etc., "D" refers to insects which dwell in wood but feed elsewhere, "W" refers to insects which eat wood, "P" are predaceous insects, "F" are those which feed on fungi and/or bacteria, "S" are scavenger animals, "N" refers to nectar feeders, and "De" refers to Detritis feeders.

MAY

Order	Family	Genus Species	Adult or Immature	Food Habits
Araneida			A	P
Coleoptera	Buprestidae	Dicera lurida	A I (April, 1978)	W
	Cerambycidae	Bellamira scalaris	A	D
	Cicindelidae	Cicindela sexguttata	A	P,I
	Elateridae		A	D
	Lampyridae		A	
Diptera	Tabanidae		A	I

TABLE 9. (continued)

MAY				
Order	Family	Genus Species	Adult or Immature	Food Habits
Diptera	Tephritidae	Tanaplagid sp.	A	I
	Tipulidae		A	I
	Syrphidae	Platycheirus sp.	A	D
Geophilomorpha			A	P
Lepidoptera	Cossidae		I(cocoon)	D(larvae, adult)

TABLE 9. (continued)

JUNE				
Order	Family	Genus Species	Adult or Immature	Food Habits
Araneida			A	P
Coleoptera	Carabidae		A	P
	Cerambycidae		A	I
	Cicindelidae	Cicindela sexguttata	A	P
	Elateridae		A	D
	Curculionidae		A	O
	Lycidae	Coleoptera ruticulatum	A	O
Diptera	Phoridae		A	F
	Siricidae	Eugnoriste sp.	I	F
	Tephritidae	Tanaplagid sp.	A	I
	Syrphidae	Eristalis sp.	I	___
Hemiptera	Aradidae		A	F,O,S
Hymenoptera	Cynipidae	Subfamily: Cynipinae	A	I
	Formicidae	Subfamilies: Myrmicinae and	A,I	D
		Campanotes sp. of Formicinae	A,I	D
Lepidoptera	Cossidae		A	___
	Nymphalidae	Vanessa atalanta	A	N

TABLE 9. (continued)

JUNE

Order	Family	Genus Species	Adult or Immature	Food Habits
Orthoptera	Gryllidae	Oecanthus fultoni	I	O
Psocoptera	Psocidae		A	F
Pulmonata			A	D,E
Phalangida			A	O,P
Spirobolida			A	S

TABLE 9. (continued)

JULY				
Order	Family	Genus Species	Adult or Immature	Food Habit
Araneida			A	P
Coleoptera	Carabidae	Bellamira scalaris	A	D
Collembola	Entomobrymidae		A	F,O
Hymenoptera	Formicidae	Subfamilies: Formicinae		
		Campanotes sp.	A,I	D
		Myrmicinae	A,I	D
Neuroptera	Chrysopidae		I	P
Phalangida			A,I	O,P
Spirobolida			___	S

TABLE 9. (continued)

AUGUST				
Order	Family	Genus Species	Adult or Immature	Food Habits
Araneida			A	P
Diptera	Piophilidae		A	—
	Tephritidae	Tanaplagid sp.	A	I
Phalangida			A,I	O,P

TIGER BEETLES

Introduction

Adult tiger beetles (Cicindela sexguttata) (Figure 20), known to occur in fifty-three counties of Ohio (Figure 21), have been observed repeatedly on paths at the Barnebey Center. The earliest sightings occurred around April 7th and copulating pairs were seen as early as April 12th. According to Shelford (1917), eggs are laid in slightly shaded areas of clay or sand containing humus. Since the adults do not move far from the breeding place, the breeding place is usually considered the true index of their habitat.

According to Donald Wilson, (1976 personal communication) biologist at the University of Maine, burrows occur in moderately acid soil (ph 5.0) where the larvae lunge out to prey on passing insects (Figure 23). He stated that the burrow holes, almost as large as a lead pencil (Figure 24) are usually found in grassy areas where the adults are common. However, during a series of searches in June and July, in areas where the adults were common, no burrows were discovered at Barnebey.

Despite the popularity of tiger beetles, and the

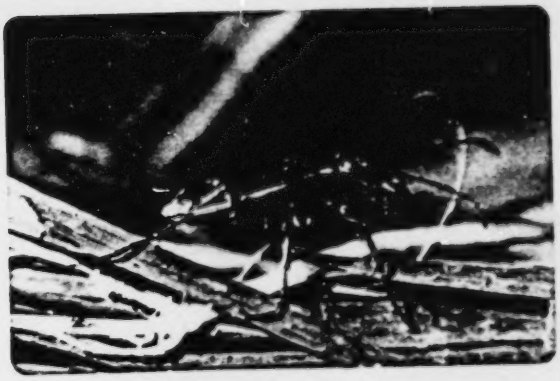

Fig. 20. The adult tiger beetle, Cicindela sexguttata, an active predator on woodland paths in Ohio.

Fig. 21. Cicindela sexguttata occurs in fifty-three counties of Ohio (from Brzoska).

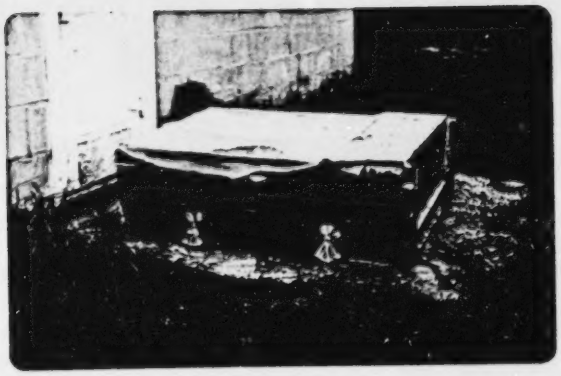

Fig. 22. Adult beetle retaining cage, built to obtain larvae.

Fig. 23. An immature tiger beetle at its burrow entrance. The strong mandibles appear black. Another burrow lies below, but the larva is not visible.

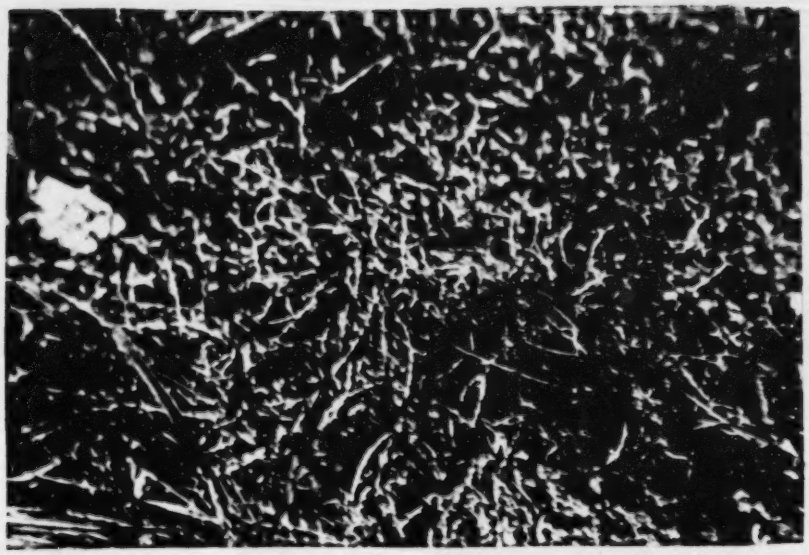

Fig. 24. The burrow holes of immature Cicindela sexguttata are almost as large as a lead pencil and are difficult to find.

abundance of this species, C. sexguttata does not appear to have attracted attention as a subject of natural history studies or popular articles, as have other species. This may be because the other species of tiger beetles lay eggs in open sandy areas where the larvae can be more easily discovered.

C. sexguttata has been reared from field collected larvae (John Stamatov: 1976, personal communication) but attempts to transplant larvae to new outdoor sites have not been reported. Norman Rumpp (1976: personal communication) suggested that introducing larvae to new sites would be too much of a shock for them to survive.

Since the larvae can provide immense enjoyment to those who make their discovery, the objective of this study was to obtain larvae and move them to a second site where they could be observed as a group. The value of the project lies in its use as a predictable discovery on an interpretive nature trail. Visitors could then observe the behavior of a stationary predator which normally would not be noticed.

Methods

To search for individual burrows is time consuming. So to obtain larvae, twenty adult beetles were confined within a cage (Figure 21) during April, May, and June. The floor was riddled with very small holes through which moisture could

drain. A layer of gravel was placed over the entire floor. Clods of soil and loose particles, collected from a site where adults were common, were placed within the cage. Flat rocks, green plants, and small branches were added. The cage was covered by a piece of 100% Dacron Polyester fabric. Sleeves were provided through which food could be introduced. The food consisted of live mealworms and live Formacine ants offered to the beetles every two days. The contents of the box were watered daily.

After larvae were discovered in the cage, ten burrows were dug up and moved in the following manner: a trowel was jabbed beneath the insect while it sat in wait at the burrow entrance. This prevented escape. The burrow shape was maintained although a lower portion of each was cut away in the process. A site was selected where the soil was similar to the site from which the adults were collected. The intact top part of each burrow containing the larval inhabitants was placed within a hole, approximately 1.6 cm. deep. Five days following the transplant, hot lead was poured into four of the larger burrows to determine burrow shape and length. Although the larvae initially had burrows no greater than the depth of the soil in the box, the move to open ground provided unlimited depth in which to burrow.

Results

On sunny days, adult activity occurred between the late morning hours and 5:00 or 5:30 P.M. Adult beetles copulated and oviposited in June. On July 26th, forty-nine larval burrows were discovered. The burrows were scattered throughout the retaining cage. Larvae could be observed at the burrow entrance as early as 8:00 A.M. and throughout the night.

Within an hour following transplant, the larvae began to dig within their burrows and appeared periodically at the surfaces of the burrows with tiny clods of earth. There, the larvae manipulated particles of soil with their mandibles and tossed them aside with head-flicking movements.

The four burrows into which hot lead had been poured, were dissected to discover any changes in burrow depth. The burrows consisted of a slightly arced portion followed by a vertical shaft of 1.3 cm.

Discussion

The adult tiger beetle, Cicindela sexguttata, can easily be captured along most woodland trails of Ohio, especially in areas of predominantly oak-hickory forest.

Confining the adult beetles from April to June is essential to acquiring a large number of larvae. Care must be observed in handling larvae in the burrows since the inhabitants may fall easily from the bottom.

According to Criddle (1907), Cicindelid larvae will migrate from their burrows if habitat conditions are not suitable. This did not occur among the ten transplanted larvae nor in the burrows that were kept indoors within a desk drawer which had been prepared in a similar manner to the retaining cage. Although the larvae were not reared completely, the project accomplished the objectives of acquisition of larvae and transplantation to a second site. The larvae were active through October. In August, 1978 they should emerge as imagos, develop color and hibernate until March, 1979 when they should emerge to breed (Figure 20).

It was possible to approach the larvae carefully to within a few inches before they would drop to the bottom of the burrows. Sounds did not affect them, since they remained at the surface despite talking and laughter nearby. Sudden movement, however, would send a larvae to the bottom of the burrow. If disturbed by gentle prodding, a sharp clicking sound of mandibles could be heard as larvae dropped out of sight.

WHIRLIGIG BEETLES

Introduction

The gregarious whirligig beetles (Family: Gyrinidae) commonly attract attention with their gyrations on the surface of rivers, ponds, streams, and lakes. Congregations of these swirling black beetles usually form near emergent vegetation.

Adult Gyrinidae commonly are maintained and displayed in aquatic aquaria with great survival success. Most recently, the Smithsonian Institution's Insect Zoo reported culturing the popular whirligigs and feeding the adults on various sorts of insects placed on the water's surface. According to Bruce Daniels, entomologist at the Smithsonian, beetles collected in September were maintained all winter in a fifteen gallon aquarium. The Insect Zoo does not maintain any outside aquatic areas for insect displays.

In developing an insect trail, there is the challenge of including a suitable aquatic habitat for active insects. Since the whirligig beetle is an active swimmer and gathers in large numbers close to shore, it was selected for study. The objective was to see whether it would accept small

habitats, and remain there. The challenge lies in retaining these small insects which fly well, and are often attracted to electric lights or shiny surfaces of automobiles.

In planning suitable habitats, the life of the immature must be considered. In spring the adult lays rows of eggs on the surfaces of the submerged parts of semi-aquatic plants. The larvae which hatch in two to three weeks, drop down to feed on bloodworms and other small aquatic insects. A mature larva will crawl on to emergent vegetation such as Cattails (Typha) or Bulrushes (Scirpus), mix an adhesive substance into the mass and form a pupal cell (Leech and Chandler: 1956).

There are three genera of Gyrinidae found in North America. According to Leech and Chandler (1956) species of Dineutus are typically stream inhabitants. Nevertheless, they can be collected by the dam on Lake Ramona at the Barnebey Center. In past summers, Dineutus had been collected on ponds and places where streams flow into ponds.

Methods

Preparatory to introducing the whirligigs, attempts were made to modify several small aquatic habitats. South of Clear Creek and adjacent to the hemlock hollow,

a section of Wildflower Run was selected. Flow was minimal. Two wire screens were buried in the stream bed to prevent drifting movement of the beetles. Fourteen beetles were placed in the water. The site was periodically checked to see whether the beetles remained. Two more introductions followed.

A cold spring was chosen next. The pool at the spring was excavated and its size increased to four meters in diameter. A screen was placed over the drainage pipe. Water depth was maintained at .75 meters. Several cattail plants and and sedges were planted, and ten whirligigs placed in the pool. The site was periodically checked to see whether the beetles had remained.

Ten gyrinids (Dineutus) were placed within a large pasture puddle of rainwater in a roadside depression. The puddle measured approximately five meters in diameter. Daily observations for five days followed.

Results

At Wildflower Run, the beetles were discovered beyond the screening on the day following the introduction. Following the other two introductions, the beetles were also discovered beyond and downstream of the wire screen. Use of the site was discontinued after heavy rains, since the beetles were able to float around the screens and dams.

The beetles at the cold spring immediately began to probe the edges of the shore and crawl over the soil. The following day, however, eight of the ten were still there. For several days, heavy rains occurred, and the small dam and screening was washed away. On the fifth day following the introduction, one beetle remained. It remained for three more days.

The beetles were never seen in the pasture puddle after they were introduced.

Discussion

Although Dineutus, known as a stream inhabitant, was originally collected at the Lake Ramona dam, its introduction to the slow-moving stream environment, resulted in its movement downstream. This movement was either by flight or overland movement, a distance of three meters. The dam and screen were secure until the heavy rainfall, so it is not possible that they floated around the barriers. The size of the dammed stream may not be the most important in causing movement of the beetles since the site was larger than the spring habitat which succeeded in retaining beetles for several days. A lack of prey species or emergent vegetation may have contributed to the movement of the beetles. These factors should be studied further to determine the

necessary requirements in maintaining Dineutus in an outdoor display.

Of the three habitats, the cold spring was the most successful in retaining the beetles. Sampling of invertebrates in each habitat might reveal potential food sources at the spring site which did not occur in the pasture puddle of Wildflower Run.

Since Dineutus has been called a stream inhabitant but was found repeatedly at Lake Ramona, observations and more introductions are needed on the movement of these beetles on the lake and stream. In the spring of 1976, an attempt to mark the beetles with nail polish resulted in death to each one. Those that were released on the lake were never seen again. The problem of selecting a marking method for aquatic specimens needs to be overcome to facilitate future observations. It may be advantageous to select Whirligig beetles in the genus Gyrineus for future introductions. Observations in past summers revealed that they were found in the slow moving eddies and pools of quick-flowing streams. It is not known, however, if those beetles had drifted in or were the same organisms.

The aquatic community represents a stationary system which should be exploited in outdoor displays of living insects. The problems associated with

developing such displays requires more time and expense than this study could provide.

CONCLUSIONS

1. The projects were successful in achieving the objectives. More work is necessary in developing aquatic habitats.

2. The butterfly projects produced information that can be very useful in future studies of the area, particular species, or in developing display gardens.

3. The remaining projects can be recommended for use in interpretive displays with no hesitation.

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SCIENTIFIC AND COMMON NAMES

Acer negundo-Box Elder
Acer rubrum-Red Maple
Achillea millefolium-Yarrow
Aesculus glabra-Ohio Buckeye
Ailanthus altissima-Tree of Heaven
Albizia julibrissin-Silk Tree
Allium vineale-Field Garlic
Ancyloxypha numitor-Least Skipper
Anemone virginiana-Thimbleweed
Anthemus cotula-Mayweed
Anthemus sp.-Golden Marguerite
Antirrhinum sp.-Lesser Snapdragon
Apocynum cannabinum-Indian Hemp
Apocynum sp.-Dogbane
Aquilegia canadensis-Columbine
Araneida-Order of Spiders
Aratidae-Family of Flat Bugs, Fungus Bugs
Asclepias amplexicaulis- Blunt-Leaved Milkweed
Asclepias incarnata-Swamp Milkweed
Asclepias tuberosa-Butterfly Weed
Atrytone ruricola-Dun Skipper
Barbarea vulgaris-Winter Cress
Boloria toddi-Meadow Fritillary Butterfly
Bombyliidae-Bee Flies
Buddleia sp.-Butterfly Bush
Buprestidae-Family of Metallic Wood-Boring Beetles
Campsis radicans-Trumpet Creeper
Carabidae-Family of Ground Beetles
Cassia fasciculata-Partridge Pea
Cassia nicitans-Wild Sensitive Plant
Catalpa speciosa-Catalpa

Centauria cyanus-Bachelor's Buttons
Cephalanthus occidentalis-Buttonbush
Cerambycidae-Family of Long Horned Beetles
Cercyonis pegala-Wood Nymph Butterfly
Chrysanthemum leucanthemum-Ox-Eye Daisy
Chrpsopidae-Family of Common Lacewings
Cicindela sexguttata-Tiger Beetle
Cirsium arvense-Canada Thistle
Cirsium discolor-Field Thistle
Coleoptera-Order of Beetles
Colias philodice-Common Sulfer Butterfly
Collembola-Order of Springtails
Cornus florida-Flowering Dogwood
Cossidae-Family of Leopard and Carpenter Moths
Cunila origanoides-Dittany
Curculionidae-Family of Snout Beetles
Danaus plexippus-Monarch Butterfly
Daucus carota-Wild Carrot
Desmodium sp.-Tick Trefoil
Dianthus armeria-Sweet William
Digitalis purpurea-Common Foxglove
Dineutus sp.-Whirligig Beetle
Diptera-Order of Flies
Dracocephalum virginianum-False Dragonhead
Elateridae-Family of Click Beetles
Entomobrymidae-Family of Springtails
Epargyreus clarus-Silver-Spotted Skipper Butterfly
Erigeron annuus-Daisy Fleabane
Erigeron philadelphicus-Philadelphia Fleabane
Eupatorium dubium-Joe-Pye-Weed
Euptychia cymela-Little Wood Satyr Butterfly
Everes comyntas-Eastern Tailed Blue

Formica fusca-a Silky Ant
Fragaria virginiana-Common Strawberry
Galium sp.-Bedstraw, Cleavers
Geomorphilomorpha-Order of small Centipedes
Geranium maculatum-Wild Geranium
Gillenia stipulata-American Ipecac
Glechoma hederacea-Gill-Over-the-Ground
Gryllidae-Family of Crickets
Gyrinidae-Whirligig Beetles
Helianthus sp.-Sunflowers
Hemaris sp.-Hummingbird Hawkmoths
Hymenoptera-Order of Bees, Ants, and Wasps
Hypericum spathulatum-Shrubby St. Johnswort
Juglans nigra-Black Walnut
Lampyridae-Family of Lightning Bugs
Lathyrus latifolius-Everlasting Pea
Lepidoptera-Order of Butterflies and Moths
Liatris aspera-Rough Blazing Star
Limenitis arthemus astyanax-Red Spotted Purple
Liriodendron tulipifera-Tulip Tree
Lonicera japonica-Japanese Honeysuckle
Lycaena phlaeas-American Copper Butterfly
Lycaena thoe-Bronze Copper Butterfly
Lycaenopsis argiolus-Spring Azure Butterfly
Lychnis chalcidonica-Scarlet Lychnis
Lycidae-Family of Net-Winged Beetles
Lysimachia quadrifolia-Whorled Loosestrife
Lythrum salicaria-Purple Loosestrife
Melilotus alba-White Sweet Clover
Mertensia virginica-Virginia Bluebells
Mimulus ringens-Square-Stemmed Monkey-Flower
Molucella laevis-Bells of Ireland
Monarda fistulosa-Wild Bergamot
Myosotis scorpiodes-True Forget-Me-Not
Myrmeleon immaculatus-Ant Lion
Nasturtium sp.-Nasturtium
Neuroptera-Order of Ant Lions and Lacewings

Nymphalidae-Family of Brush Footed Butterflies
Nymphalis antiopa-Mourning Cloak Butterfly
Nyssa sylvatica-Sour-Gum Tree
Oecanthus fultoni-Snowy Tree Cricket
Oxalis europaea-Yellow Wood-Sorrel
Orthoptera-Order of Grasshoppers, Crickets, and Mantids
Papilio glaucus-Tiger Swallowtail
Papilio marcellus-Zebra Swallowtail
Papilio philenor-Pipevine Swallowtail
Papilio polyxenes-Black Swallowtail
Papilio troilus-Spicebush Swallowtail
Passiflora incarnata-Passion Plant
Pastinaca sativa-Wild Parsnip
Penstemon hirsutus-Hairy Beardtongue
Phlox divaricata-Blue Phlox
Phlox maculata-Wild Sweet William
Phyciodes tharos-Pearl Crescent
Phylopalpus pulchellus-Handsome Bush Cricket
Prunella vulgaris-Heal-All, Selfheal
Prunus serotina-Wild Black Cherry
Prunus virginiana-Choke Cherry
Phoridae-Hump-Backed Flies
Pieris rapae-European Cabbage Butterfly
Piophilidae-Family of Skipper Flies
Polygonatum biflorum-Solomon's Seal
Polygonia interrogationis-Question Mark Butterfly
Polygonia sp.-Anglewing Butterflies
Polymonium van-bruntiae-Jacob's Ladder
Potentilla simplex-Common Cinquefoil
Psocoptera-Order of Barklice
Pulmonata-Order of Snails
Quamoclit sloteri-Cardinal Climber
Ratibida pinnata-Gray Headed Coneflower

Rubus sp.-Blackberry
Rudbeckia sp.-Coneflower
Salpiglossis grandiflora-Salpiglossis
Salvia officinalis-Garden Sage
Saponaria officinalis-Bouncing Bet
Saxifraga virginiensis-Early Saxifrage
Sciaridae-Family of Dark-Winged Fungus Gnats
Scirpus sp.-Bulrushes
Spirobolida-Order of the large Millipedes
Scutellaria incana-Downy Skullcap
Solidago sp.-Goldenrod
Speyeria aphrodite-Aphrodite Fritillary Butterfly
Speyeria atlantis-Atlantis Fritillary Butterfly
Speyeria cybele-Great Spangled Fritillary Butterfly
Stachys palustris-Woundwort
Strymon falacer-Banded Hairstreak Butterfly
Syrphidae-Family of Flies
Tabanidae-Family of Horseflies, Deer Flies
Taraxacum officinale-Common Dandelion
Tephritidae-Family of Peacock Flies
Thymus sp.-Thyme
Tipulidae-Family of Crane Flies
Trifolium pratense-Red Clover
Typha sp.-Cattails
Valerianella olitoria-Corn Salad
Vanessa atalanta-Red Admiral Butterfly
Vanessa cardui-Painted Lady Butterfly
Vanessa virginiensis-American Painted Lady Butterfly
Vernonia novaboracensis-New York Ironweed
Verbena sp.-Vervain
Veronicastrum virginicum-Culver's Root
Vicia sativa-Spring Vetch
Viola sp.-Violets
Zinnia sp.-Zinnias

APPENDIX

2086 Neil Ave., Apt. 22
Columbus, Ohio 43210
August 1, 1976

I am a graduate student at Ohio State University in the Department of Natural Resources planning to develop about one acre of land specifically for the study, observation, and photography of native Ohio insects in their natural habitat. The habitat of several species in particular will be managed to encourage their colonization or acceptance of a new habitat. The area is being planned specifically for students, teachers, and the general public for environmental education purposes. Such concepts as predation, camouflage, and mimicry could be taught here. I hope to attract such common forms as ant lions, tiger beetles, ground beetles, and mole crickets.

I am interested in knowing if your facility has any area such as this for educational purposes. What part do insects play in your educational program? How important do you consider insects to be in your program dealing with environmental awareness?

Any information provided in these areas of concern would be gratefully appreciated.

Sincerely,

Susan G. Kains

Susan G. Kains

SGK/lm

A GUIDE TO JULY BUTTERFLY-WILDFLOWER OBSERVING IN OHIO'S CLEAR CREEK VALLEY AND SEVERAL ADJOINING AREAS

by

SUSAN G. KAINS

CONTENTS

Introduction Page

Terrain..... 1

Time Involved..... 2

References and Equipment..... 3

Identification of Butterflies..... 6

The Life of a Butterfly.....11

Places to Visit.....13

Butterfly Conservation.....31

Illustrations

How to Make an Aerial Sweep Net..... 5

Examples of Comparative Characteristics of Lepidoptera..... 9

Map of the Clear Creek Valley and Vicinity.....33

Map of the Muddy Prairie.....34

INTRODUCTION

During July, the height of the butterfly flight season, the Clear Creek Valley in Fairfield County abounds in the exquisite wildflowers which are so important in nourishing the diverse and abundant butterfly fauna of the area. Clear Creek Road is well known as an excellent spot to observe large mud puddle clubs of skippers and swallowtail butterflies. This guide is intended to acquaint butterfly enthusiasts with the excellent places to observe butterfly-wildflower interactions. Newly interested "butterfliers", students photographers and biologists will be able to eagerly anticipate taking to the fields with this guide in hand. It suggests the highlights of the area where elegant summer wildflowers have attracted our native butterflies in the past and will continue to do so, as long as these wild spots remain undeveloped and bountiful in local flora.

Terrain

The terrain to be encountered varies from level ground at Wahkeena and the Barnebey Center to the gentle slopes of the Geneva Hills and Camp Wyandot.

Sturdy footwear will prove useful in descending the steep banks of the North Curve Swath of Barnebey Road.

Although bogs usually bring to mind visions of bounsing mats of plants, the site in Amanda is generally quite dry. Any patches of water can easily be avoided to maintain dry feet.

Time Involved

The amount of time needed to complete the tour is dependant on the particular activity interest of the participant. A sunny afternoon between the hours of eleven and five o'clock is suggested, since this is the height of the butterfly flight time. If one wishes to visit all sites within these hours of an afternoon, with approximately fifteen minutes at each site, a total of three hours and fifteen minutes may involve field rovings with a total of two hours and thirty minutes travel time between sites necessary. For a more leisurely pace, with time for photography or more careful observations, it might be worthwhile to select a portion of the sites to visit at first, with plans to return another day. This guide also offers suggestions for convenient parking at each site.

References and Equipment

Notice the page reference accompanying the names of each species of butterfly and wildflower. These refer to A Field Guide to the Butterflies by Alexander Klots and A Field Guide to Wildflowers by Roger Tory Peterson and Margaret McKenny, both of the Peterson field guide series. These books offer pointers in learning to identify butterflies and some natural history of each. References to pages in the butterfly guide are indicated by the author's initial, K.206 and in the wildflower guide with P.&M. 252.

Binoculars are useful instruments when you want to observe butterflies. Some large high fliers often do not need to be captured for identification because even the sex can be recognized at a distance. If you approach a feeding butterfly quietly, and avoid making quick movements, you may be able to touch it, as it could be unaware of your presence.

The butterfly photographer will have more equipment than others, including either a macro lens or bellows and a 135 mm. telephoto lens, strobe flash unit, and cords. A knapsack or shoulder pack will prove useful in carrying field guides, envelopes, camera equipment, notebook, and pencil.

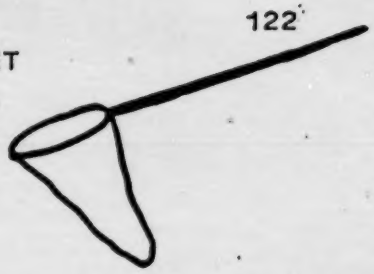
A collection jar should be prepared several days in advance of the trip. It will allow you to asphyxiate specimans in the field for studying at home. From the jar they should be transferred to glassine envelopes.

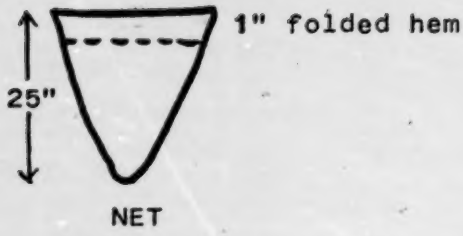
To prepare a jar, place a mixture of Plaster of Paris and water in the bottom few inches of the jar. Allow it to dry for one or two days. Ethyl acetate should be poured into the bottom of the jar where it will be absorbed by the plaster. A paper towel placed over it will keep the butterfly dry. Wrap the bottom of the jar with adhesive tape to prevent any injury if the bottle breaks.

Aerial sweep nets, commonly referred to as butterfly nets, are available through mail-order biological supply houses and usually locally at natural history museums or nature centers. It is very easy, however, to construct a perfectly adequate net in several hours.

Writing down observations of particular butterflies in a small pocket-sized notebook may have value to yourself and others. Other information to include might be the place of collection, the weather conditions, the date, and the usage of the land where the butterflies were discovered. Subsequent trips might be worth planning, especially in particularly productive areas.

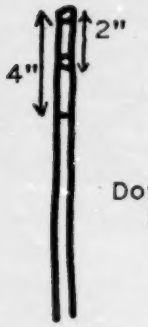
HOW TO MAKE AN AERIAL SWEEP NET





NET

WIRE COATHANGER



Dowel rod about
3 feet long

Handle with pipe fitting

Handle with pipe fitting, coat
hangar, and epoxy on knife

Materials

Epoxy glue
Plastic knife
Metal or plastic
pipe fitting
Dowel rod
Coat hangar
Needle, thread, and
scissors
1 yard of 100% Dacron
Polyester material

Directions

Prepare the glue
according to the
directions on the
tubes and apply it
with knife to inside
of pipe fitting. Allow
to dry overnight.

Information exchanges between butterfly enthusiasts can lead to more interesting discoveries and new field comrades. The movement for conservation of butterflies has prompted enthusiasts to maintain careful information to be used as indices of habitat quality.

Identification of Butterflies

Lepidoptera is the term applied to butterflies, skippers, and moths collectively. The word is derived from the Greek words lepis meaning scale and pteron meaning wing. Scales are hairlike processes covering the body of a Lepidopteran insect and they function as insulation to the insect. They appear powdery when rubbed off on to human hands. Some scales contain glands which serve to attract the opposite sex.

There is not one single identifying characteristic which serves to seperate butterflies and skippers from moths. Instead, utilizing the combination of characteristics in the following table, will lead to quick recognition of Lepidoptera.

COMPARATIVE CHARACTERISTICS OF LEPIDOPTERA

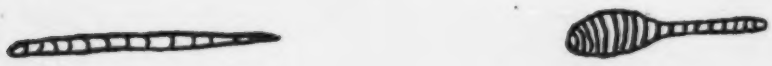
	BUTTERFLIES	SKIPPERS	MOTHS
TIME OF FLIGHT	Daytime; sometimes at lights	Daytime	Some are day fliers; most at night
WING POSITION AT REST	Held upright over body	Held upright over body	Held flat over body or at sides
WING COUPLING	Wings held together by expanded edge of hindwing	Expanded edge of hindwing (called humeral angle)	a bristle locking on to forewing (frenulum)
WING VEINATION	at least one vein of forewing is branched	all veins of forewing are branched	variable
WING SIZE	proportionately large to body	proportionately small to body	variable

124

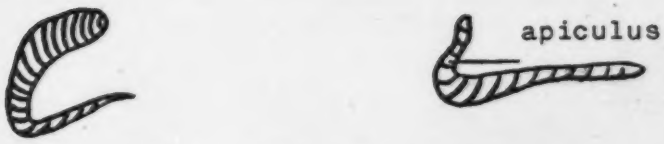
COMPARATIVE CHARACTERISTICS OF LEPIDOPTERA

	BUTTERFLIES	SKIPPERS	MOTHS
LARVAE	with spines or bristles	dull colored, with few hairs, head patterns	with spines, bristles; colorful
PUPAE	brilliantly colored	fastened by silk thread in a cocoon	usually brown;,ifunder-ground, no cocoon
ADULT COLORATION	usually brilliant	usually dull colored	night fliers are dull; day fliers brilliant
GENERAL SHAPE	slender	stout	variable
ANTENNAE	arise close together on head; clubbed part extends to tip	arise far apart on head and tip bends backwards; apiculus present	hairlike or comblike and feathery
FLIGHT	swift not darting	flight is swift, darting, erratic	some hover darting, erratic

EXAMPLES OF COMPARATIVE
CHARACTERISTICS OF LEPIDOPTERA



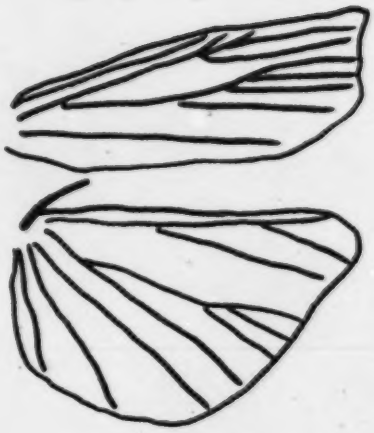
Antennae of Butterflies



Antennae of Skippers

Antennae of Moths

Expanded edge (the humeral angle) of the hind wing



A Frenulum

There are nine families of true butterflies and two families of skippers. These are listed below with page numbers which refer to the family characteristics described in A Field Guide to the Butterflies by Alexander Klots. For more technical identification, refer to the key on page 59. Colored plates, however, offer family characteristics and accompanying descriptions of species. Always be sure to check distribution of the butterfly in question.

Problems in identification of skippers are common since many are similar in coloration. These problems can be alleviated by carefully referring to the descriptions in the suggested field guides as well as in the text of this booklet.

Family	Page Number
Satyridae-Wood Nymphs	66
Danaidae-Monarchs	77
Heliconidae-Heliconians	79
Nymphalidae-Brush-footed butterflies	83
Libytheidae-Snout butterflies	120
Riodinidae-Metalmarks	121
Lycaenidae-Gossamer-winged butterflies	125
Papilionidae-Swallowtails	171
Pieridae-Whites and Sulphers	181

Family	Page Number
Hesperiidae-True Skippers	203
Megathymidae-Giant Skippers	274

The Life of a Butterfly

Imagine it is a sunny exhilerating day in July. Slight twitterings and colorful movements attract curious eyes to explore the edges of sunny glades. Butterflies are discovered beneath the leaves of living plants, depositing eggs, no larger than the size of the head of a pin.

The life cycle of a butterfly begins on the underside of a leaf where the larva emerges after several days and immediately begins to feed. As it does, it grows, forcing the skin to be shed five times. The final skin is shed when the larva stops eating and constructs a silken chrysalis. Inside the fragile pouch an incredible transformation occurs. Eventually a crack develops and an adult butterfly appears, dries its wings, and flies away to search for food. Its long, curled-up tongue functions like a soda straw to enable it to suck up nectar from brilliantly colored wildflowers. The nutrition from the nectar helps it to sustain life,

as did the moisture on hot days. Large gatherings of butterflies at the edges of puddles, deserve careful attention, since these are some of the finest sights of the American countryside. Each kind of butterfly selects a favorite foodplant upon which to lay its eggs where the larva (caterpillar) will develop and live out its life. With the coming of winter, butterflies seek protection from cold temperatures. The Monarch butterfly moves southward to Mexico. Others seek out an out-of-the-way place among branches, brush-piles, or cracks in wooden fences. With the advent of warm weather, people take to the fields to find butterflies.

PLACES TO VISIT

1. Wahkeena Preserve (Ohio Historical Society)

County Road 274 (Pump Station Road)
Lancaster, Ohio 43130

Location: 9.5 km. (5.8 miles) south of Lancaster

Directions: Drive south on State Route 33 turning right on to Old Logan Road. Follow the road to Pump Station Road. Turn left. The preserve is up the road on the right. Parking space in the lot.

Here you will see territorial Silver-Spotted Skippers (Epargyreus clarus, K.209) attempting to drive away intruders, both human and insect, from the blooming Buttonbush balls and nearby Purple Loosestrife (Lythrum salicaria, P.&M.288). The larger butterflies here, alert to its antics, somehow feed successfully, despite the buzzing and chasing. On a clear and sunny day, the skippers are the first arrivals at the feeding bush. They arrive around 8:00 A.M. Within an hour, the pace quickens with the arrival of the Tiger Swallowtails (Papilio glaucus, K.161), Great Spangled Fritillaries (Speyeria cybele, K.65), Atlantis Fritillaries (Speyeria atlantis, K.65), and Spicebush Swallowtails (Papilio troilus, K.193). The attractive fragrance of the blooming Buttonbush affords the butterflier an

opportunity to view the swallowtails, high fliers which rarely come near the ground. If you stand very still, a Hummingbird Hawkmoth (Hemaris sp., not pictured) may approach to within a few feet lazily probing each blossom, then suddenly zooming up to fly away. These diurnally feeding (daytime) moths must beat their wings with great rapidity to hover over flowers while sipping nectar with a long straw-like proboscis. Collecting nectar, as they hover in mid-air, is a most elegant mode of insect pollination and fascinating to observe. It sometimes requires a few attempts before efficiency is reached in inserting the proboscis into a particular type of flower. A hawkmoth must learn to associate the scent and pattern of a flower with the presence of nectar.

2. Pipeline Swath at Geneva Hills Camp
(Presbytery of Scioto Valley)

1380 Blue Valley Road
Lancaster, Ohio 43130
614-746-8439

Location: 10.7 km. (6.6 miles) south of Lancaster off State Route 33, to County Road 67, then Blue Valley Road.

Directions: Return to Old Logan Road and turn left. Turn left again on to Blue Valley Road. Signs indicate the entrance to the center on the right, directly across from a large barn.

Perhaps some of the most spectacular scenes in summer are the waste places of roadsides, edges of railroad yards, and particularly in this area, the well-defined swaths created by the insertion of the gas pipelines into the ground. Although the cut areas initially mar the landscape, a few seasons pass and plant succession revives the soil, allowing some of the spectacularly colored weed-wildflowers to proliferate. Such an event occurred here. The diversity of butterflies which exist by Picnic Area 1, above the Mixed Mesophytic Slopes (map 1, number 3) includes the Little Wood Satyr (Euptychia cymela, K.64), Wood Nymphs (Cercyonis pegala, K.64), Eastern Tailed Blues (Everes comyntas, K.160), Pearl crescents (Phyciodes tharos, K.112), various

skippers and Swallowtails. Later, in mid August, at similar swaths in the area, observers who favor brilliance of color in the landscape should be certain to return for the spectacular sight of the pinkish-purple Blazing Stars (Liatris sp., P.&M. 282), sometimes called Button Snakewood. Unlike most other spiked flowers, the Blazing Star blooms down the stem rather than upwards. New York Ironweeds (Vernonia noveboracensis, P&M298) and most field thistles are equally attractive to the Lepidoptera.

4. North Curve of Barnebey Road

Location: Immediately south of the junction of Revenge Road and Barnebey Road (map 1).

Directions: Continue driving west on Blue Valley Road. Turn left at the intersection (State Route 793). At the Fairfield School for Boys, turn left at the first intersection in the middle of the campus. Drive approxamately 4.5 km. (2.7 miles). Turn left at the white farmhouse which appears on the left hand side of the road Several hundred feet down the road is the left handed North Curve.

Several downhill paths guide observers among the flamboyant magenta of Everlasting Pea (Lathyrus latifolius, P.& M. 252), so attractive to Hummingbird Hawkmoths (Hemaris sp.), Silver-Spotted Skippers (Epargyreus clarus, K.206), Great Spangled Frittillaries (Speyeria cybele, K.65), and Spicebush Swallowtails (Papilio troilus). A sharp observer might discover Aphrodite (Speyeria aphrodite, K. 165), an eager visitor to the Blunt-leaved Milkweed (Asclepias amplexicaulis, (P.&M.294) and Field Garlic (Allium vineale, P.&M.296) blooming here. Although its flight is quicker than that of other fritillaries, it is less wary and may be approached during feeding. Look for the black spot on the upper surface of the forewing near the base of the wings. This distinguishes Aphrodite from the Great

Spangled fritillary. Black-eyed Susans (Rudbeckia hirta, P.&M. 112) attract the American Painted Lady (Vanessa virginiensis, K. 113), and the pugnacious little Pearl Crescent (Phyciodes tharos, K.112). A variety of skippers can be observed feeding on nectar of the Red Clover (Trifolium pratense, P.&M. 246). Monarch larvae (Danaus plexippus, K.81) can be discovered in mid July and photographed easily on the milkweeds.

Every school child learns to recognize the Monarch Butterfly not only by sight but by name. Not until 1975, however, did anyone know the whereabouts of the migrant monarchs' wintering grounds. Following the paper tagging of several hundred thousand of them by the Insect Migration Association, Canadian Zoologist, Dr. Fred Urquhart, traced their route to the Sierra Madre of central Mexico. There among the great oyamel trees, the millions of monarchs converg. Imagine acres of the towering evergreens, each one covered with the resting monarchs, from ground to tip. Branches several inches thick have been known to break under their weight. The monarchs which you have seen in Ohio are the offspring of last years migrants whic' began to fly northward, flew only part way, laid eggs, and died.

On particularly sunny days, you might wish to jaunt into the cool shade of the woods to the southwest of the

rocky slope at this swath. This excursion might produce the sighting of a Wood Nymph butterfly (Cercyonis pegala, p.64). Known for resting on trees, Wood Nymphs have been seen here sipping moisture from injured trees which exude sap.

5. The Prairie at the Barnebey Center for Environmental Studies (Ohio State University)

Rural Route 2
Clear Creek Road
Lancaster, Ohio 43130
(614) 653-0708

Location: 8.5 km. (5.2 miles) west of State Route 33 on Clear Creek Road.

Directions: Continue down Barnebey Road (gravel and dirt), past the hilltop buildings to the field on the left before the steep hill. Park at the roadside. The Prairie occupies the slope from the pines in the northeast to the woods in the southwest.

A very large and showy plant, the Purple Coneflower (Echinacea purpurea, P.&M. 308) is found in full splendor during July at the Barnebey Prairie. Standing three feet tall or higher with downswept pink rays, this Composite is difficult to overlook in passing. The best-known fritillary, the Great Spangled Fritillary (Speyeria cybele, K.65), with great silver spots on the underside of the hindwings, regularly visits the flower for its nectar. Earlier in the season, Canada Thistles (Cirsium arvense, P.&M. 304) at the Barnebey parking lot nourish these beauties and it is a common sight to see eight to ten feeding at once. As July advances, the coneflowers' simplistic yet highly colorful display lures the fritillaries down the hill. The larvae of this butterfly hibernate immediately after hatching and

the following spring they feed on violets during the night hours. At the Barnebey Prairie, the presence of healthy Red Clover (Trifolium pratense, P.&M. 246) may allow you the possibility of discovering Spicebush Swallowtails (Papilio troilus, K.193), and Hummingbird Hawkmoths.

6. Barnebey's Roadside at Clear Creek

Location: About 0.5km. (0.3miles) west of the Barnebey Center entrance; at the path leading from the road to Lake Ramona, and by the fence and gate to the swinging bridge.

Directions: Continue down the hill of Barnebey Road, making a right-hand U-turn on to Clear Creek Road. Continue for 0.5 km. (0.3 miles) and park off the road.

Here at the moist roadside and paths, occur the greatest concentrations of butterflies in the valley. In April, huge clusters of Tiger and Spicebush Swallowtails (Papilio glaucus, K.161 and P. troilus, K.193) will sip moisture from sand or mud within inches of careful observers. Later, iridescent, blue-colored Red Spotted Purples (Limenitis arthemis, K.128) visit the spot for mud-moisture or sugars within the fox and raccoon droppings on the paths. This butterfly favors woods and edges but is not limited to those places. More challenging butterflies to net could only be the Tiger Swallowtails or the Question Marks (Polygonia interrogationis, K.144). All three species frequent this site in July so if you are interested in netting them, allow time for these elusive yet taunting fliers.

Bordering the path to the bridge, beyond the metal

gate, blossoms of Square-stemmed Monkey Flower (Mimulus ringens, P.&M. 344), Jewelweed (Impatiens bicolor, not pictured in guide; see I. pallida, P.&M. 104), Wild Bergamot (Monarda fistulosa, P.&M. 216), and Wild Sweet William (Phlox maculata, P.&M. 226) attract the roadside puddle-visiting butterflies. An abundant roadside summer pink, Bouncing Bet (also known as Soapwort for the roots which produce a lather in water) (Saponaria officinalis, P.&M.266) forms a great colorful display here for the nectar-seeking Spicebush Swallowtails and Hummingbirds. Butterflies differ greatly in their choice of plants from which to sip nectar. Some will visit a variety of flowers yet others will visit blossoms of only a few plants. Bouncing Bet, a typical roadside flower, has such a long calyx that only insects with an extremely long proboscis can reach the nectar within the flower.

7. Old Field of Barnebey Center near the Swinging Bridge

Walk across the swinging bridge and descend to the path on the other side of the creek. Follow the small footpath to the left among the grasses and weeds. Be alert to the twisting flip-flap flight of the Little Wood Satyr (Euptychia cymela, K.64). A weak flier, it can usually be found flitting about wet areas of grasses and shrubs. When alarmed it will seek safety near the ground. Little Wood Satyrs are a great challenge to net as they dodge through vegetation and sometimes crawl under leaves. To see a feeding satyr is a special experience since they do not readily do this. The overgrown plant wealth of the Old Field before you will hide most insect inhabitants. Strike off the path and walk among the golden blossoms of Shrubby St. Johnswort (Hypericum spathulatum, P.&M.138), more attractive to bees than butterflies. Seek out the Indian Hemp (Apocynum cannabinum, P.&M.70). Various skippers and the iridescent green and orange Dogbane Beetles may reward a patient observer with a visit. Watch for the Monarch (Danaus plexippus, K.81) sipping nectar from Yarrow (Achillea millefolium, P&M.44) and Ox-eye Daisy (Chrysanthemum leucanthemum, P&M.92).

As the Eastern Tailed Blue (Everes comyntas, K. 176) feeds on White Sweet Clover (Melilotus alba, P.&M.80), you may even see its tiny tails in motion. The iridescent blue of the male is evident even as the wings are folded over the back. Females are more brownish on the wings with more fully developed front legs than those of the males.

8. Broomsedge Meadow of Camp Wyandot (Columbus Campfire Girls)

Location: About 4.7 Km. west of State Route 33 on Clear Creek Road (2.9 miles).

Directions: The resident manager should be notified of your presence at the camp. He may be found within the camp or at the house on the north side of Clear Creek Road on the hill.

Enter the main gate and follow the road lined by Rhododendrons and Hemlocks. Parking is available at the lot. Walk past the cabin line, up the hill, over the fence style, to the meadow.

Watch out for the pugnacious and iridescently tinted American Copper (Lycaena phlaeas, K.176). Its practice of buzzing larger butterflies, birds and even animals, draws attention to this small common member of the gossomer-winged butterfly family. Sheep sorrel (Rumex acetosella, P.&M.310), the larval foodplant, has attracted it here. If you missed several butterfly species at your first stops, you might have another opportunity to see them here.

9. Willow Bottomland of Camp Wyandot

A short walk down the slopes, in the area of the willow trees, is a place where Nettles thrive (Urtica sp., P.&M.382), attracting Red Admirals (Vanessa atalanta K.107). Nettles are the larval foodplant. The larvae draw together the edges of its leaves with silk, and there they pupate.

10. Oak-Hickory Ridgetop of Camp Wyandot

Up the western slopes, across the Wet Sedge Meadow (map1, No.11), over the stream, and beyond the next meadow, the oak-hickory ridgetop is an enticing haunt to the butterfly enthusiast. Here, one may take pleasure in the salient erratic flight of the Pipevine Swallowtail (Papilio philenor, K. 192), so abundant in July. To view the shimmering metallic flight of this butterfly on a sunny summer day is well worth the short climb to the ridgetop via the rocks at its westernmost edge. The larvae of this Swallowtail feed on Dutchman's-Pipe vines (Aristolochia durior, P.&M.240). The Pipevine Swallowtail was once one of the most common butterflies around Canton, Ohio where homes displayed the vines growing around porches. Reports indicate that none of the vines are left and the butterfly is gone from the area.

12. The Muddy Prairie of Amanda Bog

Location: 1 km. north of Amanda (map 2)

Directions: Return to Lancaster via State Route 33. Turn left on State Route 22 and follow it to the north edge of Amanda. Turn right on North School Street to the first white farmhouse on the left. The bog is directly north of the house and driveway. Park along the road.

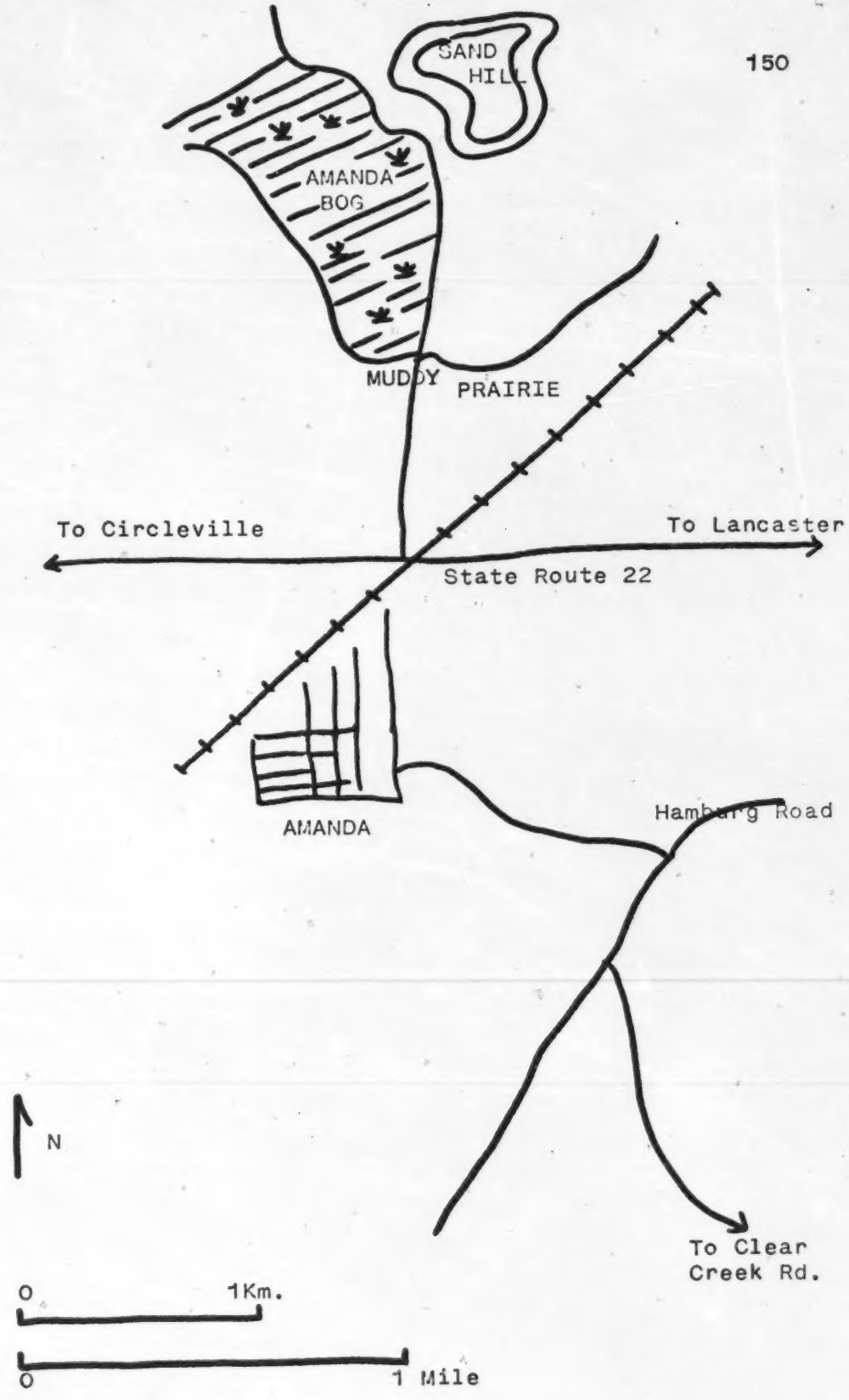
The glaciers which once occurred in Fairfield County left behind lacustrine (lake) deposits from which geologists have determined the locations of lakes formed when the ice receded. A post-glacial lake in this area formerly covered the Muddy Prairie near Amanda. In the History of Fairfield and Perry Counties, Ohio, Their Past and Present, A.A. Graham in 1883 described the area as "about one-half mile in width and three in length and could be shaken perceptibly for rods around by treading heavily upon the ground." It was then an area of low and marshy peat where great danger existed in crossing. Today the Amanda Bog, partially tiled and drained, exhibits soil evidences of peat. Walking among the grasses, willows, roses, iruses, and boneset, one might find as many as nine species of butterflies here, so anyone visiting should be sure to watch for something that may

have been missed. The Common Sooty Wing (Pholisora catullus, K.218) has been observed here, as well as various Anglewings (Polygonia sp.). The orange flashy color of the Least Skipper (Ancyloxypha numitor, K.272) is prominent among the tall grasses of the Bog's edge. Also look for Red Admirals, Cabbage Butterflies, Spicebush Swallowtails, Silver-Spotted Skippers, Sulphers, and Pearl Crescents.

BUTTERFLY CONSERVATION

In April, 1976, the Fish and Wildlife Service applied the Endangered Species Act to six butterflies and is working to include more species. The active conservation of insects, has developed from the wildlife conservation movement, and is presently upon us. For years, pesticides were thought to cause declining populations of butterflies, but the primary factor is known now to be destruction of habitat. Many species are already extinct and each year, more vanish. North American butterflies suffer from unrestrained urban growth as well as unrestrained all-terrain vehicles. An early loss, that of the Xerces Blue, in the San Francisco Bay area, prompted the establishment of the Xerces Society, an organization which works through political, scientific, and societal channels to combat destruction of habitat for populations of Lepidoptera. Recent advances have been made in saving the El Segundo Blue in California. Standard Oil has co-operated in the effort. In New York, Xerces is working to protect the habitat of the Karner Blue, an area known as the Albany Pine Bush. Families who live on the edge of the bush, have planted wild lupines to encourage the butterflies to their gardens.

The value of butterflies to man is recognized by their use in studies of mimicry, hybridization, industrial, melanism, and physiology of metamorphosis. Butterflies as pollinators are vital to the survival of many flowering plants. They also are one of the finest elements of the American countryside and serve as an important natural resource through their beauty and popular interest. Through the annual fourth of July Butterfly Census, butterfly enthusiasts, both amateur and professional, take to the fields during one day in July, to see what butterflies can be found. Records of the census are maintained by the Xerces Society and will be valuable information in determining abundance of butterflies. For more information concerning the Butterfly Census, contact Xerces Census Chairman, P.O. BOX 123, Durham, New Hampshire 03824.



MAP 2. AMANDA BOG (MUDDY PRAIRIE)

OVERSIZE MAP ENTITLED "THE CLEAR CREEK VALLEY AND VICINITY"
DELETED PRIOR TO BEING SHIPPED TO EDRS FOR FILMING.